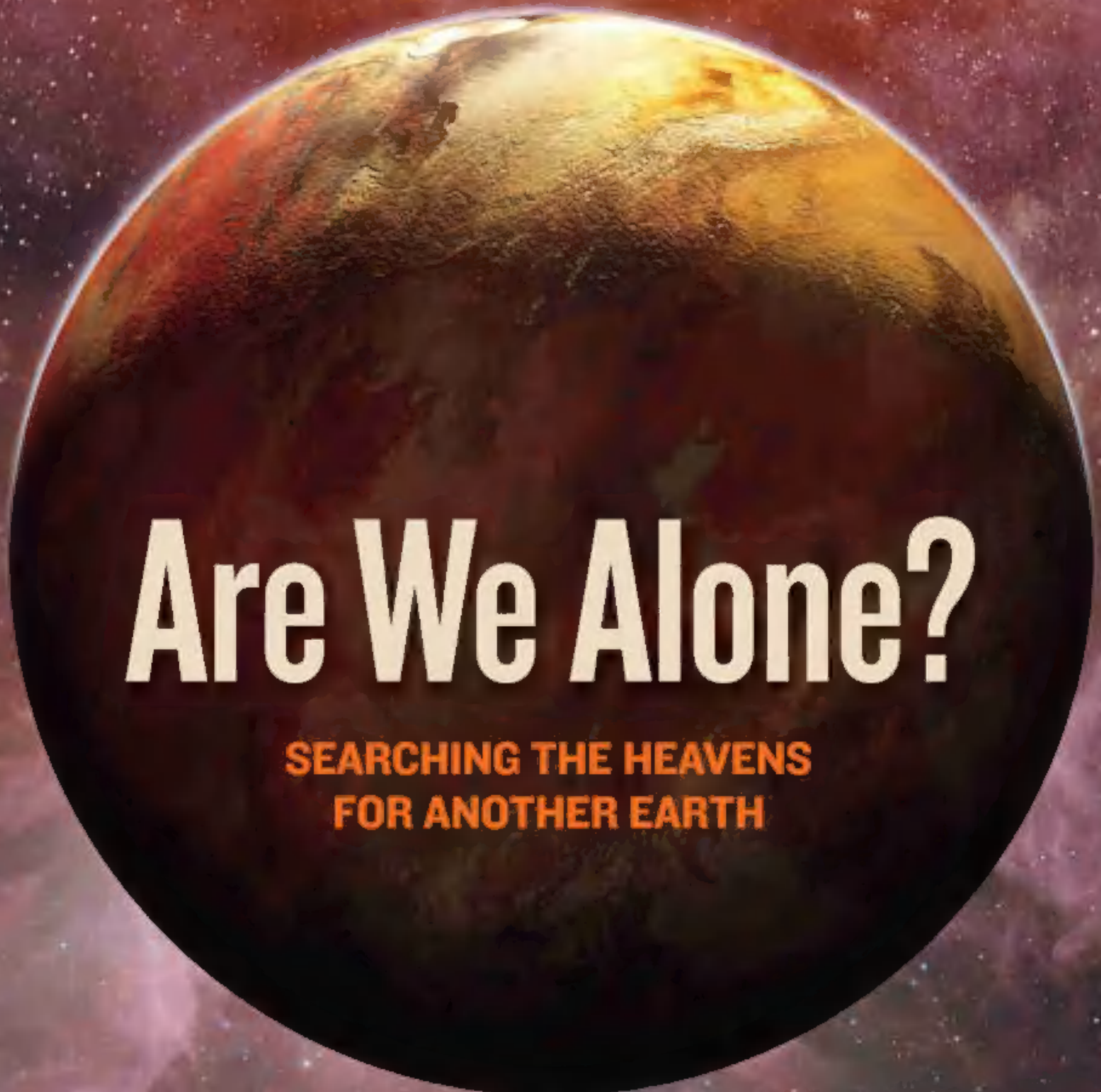


# NATIONAL GEOGRAPHIC



## Are We Alone?

SEARCHING THE HEAVENS  
FOR ANOTHER EARTH

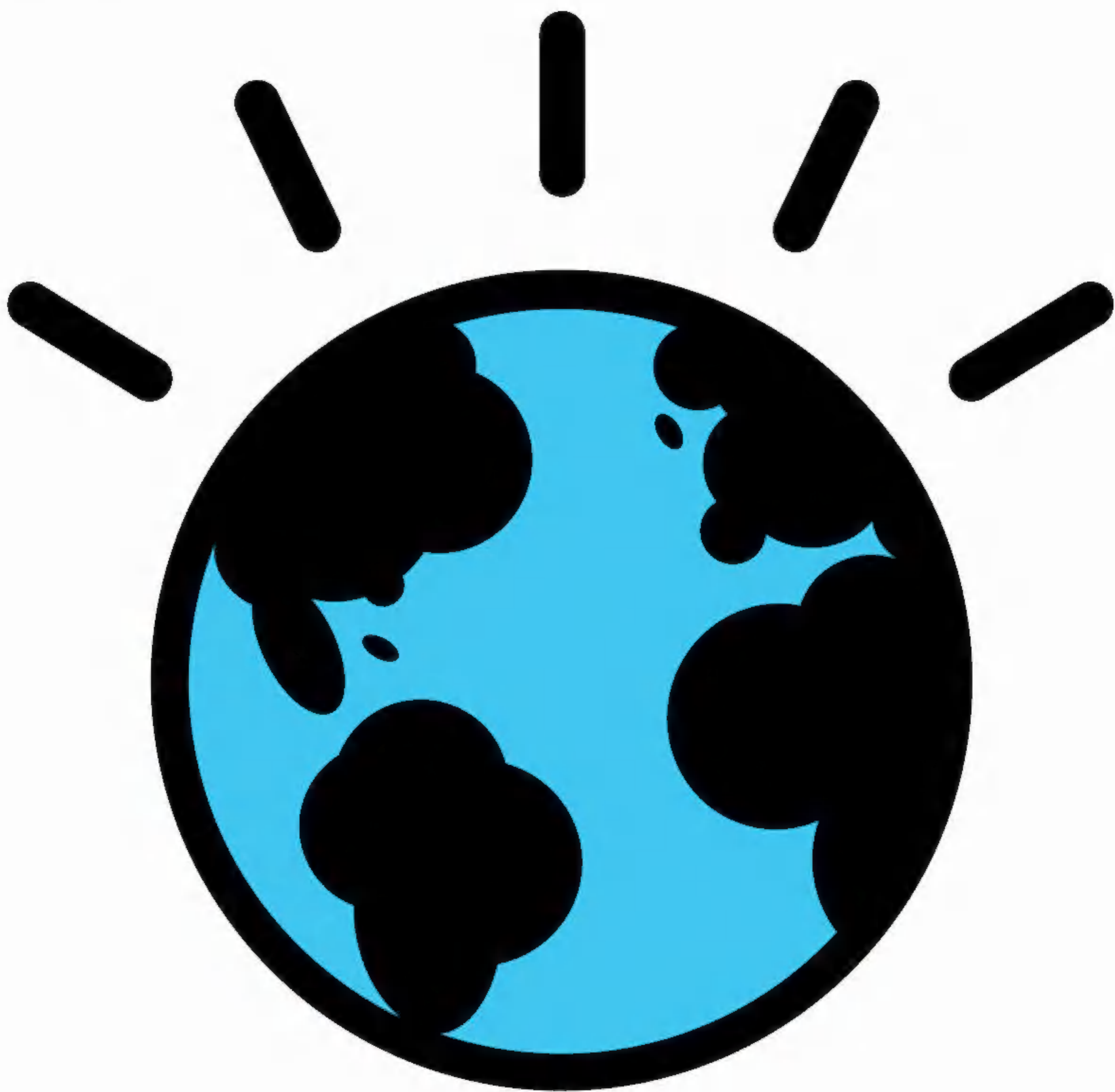
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Conversations for a Smarter Planet

## A mandate for change is a mandate for smart.

The world is ready for change – that much is clear.

For leaders of all kinds, this moment presents a rare opportunity. Our planet is not just getting smaller and flatter. It is also becoming smarter. And that means we have the potential to change the way the world literally works.

Computational power is now being put into things we wouldn't recognize as computers – cars, appliances, cameras, roadways...even pharmaceuticals and livestock. We are interconnecting all of this through the Internet, which has come of age. And we are applying powerful new systems and sophisticated analytics to turn oceans of data into insight, knowledge and intelligence.

Consider the changes already under way.

Smart traffic systems are helping to reduce gridlock by 20%, cutting pollution and increasing ridership on public transit.

Smart food systems based on RFID technology embedded into supply chains are monitoring meat, poultry and other items from the farm to the super-market shelf.

Smart healthcare systems are helping to lower the cost of therapy by as much as 90%.

Police departments are correlating street-level information from myriad observations and devices to identify crime patterns – helping prevent crime, rather than simply punishing it.

The list is long, and the transformation is just beginning. Its benefits will be reaped not only by large enterprises, but also by mid-sized and small companies – the engines of economic growth everywhere – and by individuals and communities around the world.

Imagine how a smarter planet will transform *all* the things we seek. The ways we pursue economic growth, societal progress, environmental sustainability and cures for disease. The way we interact with each other and with the world.

The opportunity is before us, and the moment will not last forever. Will we seize it? As we look to stimulate our economies and rebuild our infrastructure, will we simply repair what's broken? Or will we prepare for a smarter future?

Join us at [ibm.com/smarterplanet](http://ibm.com/smarterplanet)

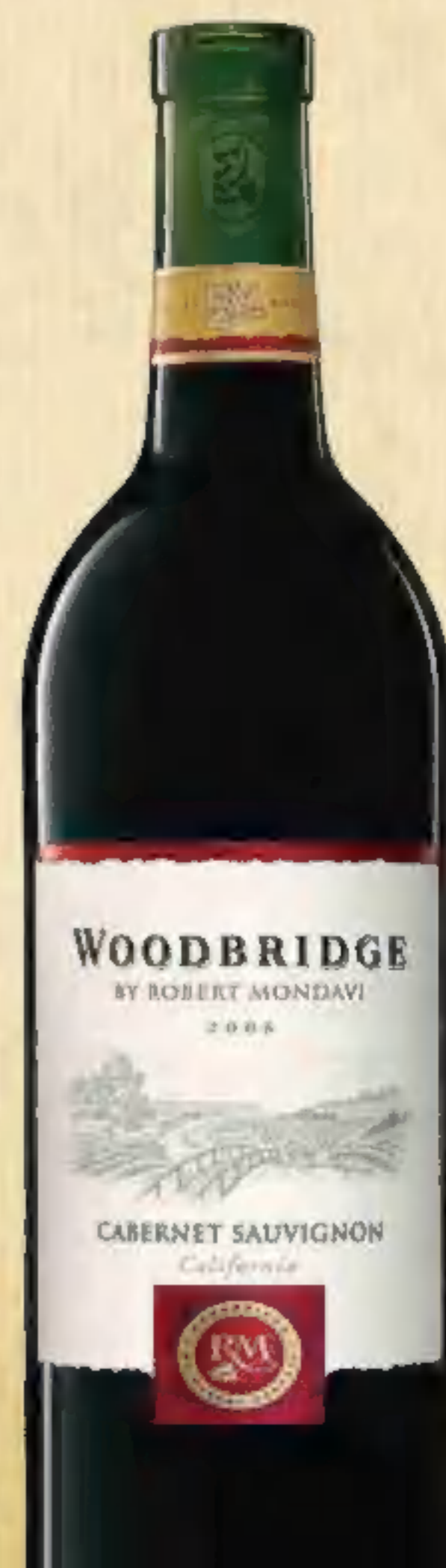


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His wines changed a country.

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WOODBRIDGE  
*by Robert Mondavi*



# NATIONAL GEOGRAPHIC

DECEMBER 2009 • VOL. 216 • NO. 6

- The Other Tibet** **30** The Uygurs of China's oil-rich far west are facing a crisis.  
*By Matthew Teague Photographs by Carolyn Drake*
- Resurrection Island** **56** Once a scene of slaughter, South Georgia is awash with life.  
*By Kenneth Brower Photographs by Paul Nicklen*
- Searching for New Earths** **78** Distant worlds are being discovered. Is one of them like ours?  
*By Timothy Ferris*
- The Hadza** **94** Tanzania's hunter-gatherers live 10,000 years in the past.  
*By Michael Finkel Photographs by Martin Schoeller*
- The Mating of Plants** **120** Let's not be coy: Pollen is plant sperm, and it's born to ride.  
*By Rob Dunn Photographs by Martin Oeggerli*
- Monks of Mount Athos** **134** They can be zealous, reclusive, worldly, prayerful, defiant.  
*By Robert Draper Photographs by Travis Dove*



Typically a scavenger, the northern giant petrel incessantly pecked the photographer and his camera with its big beak. Story on page 56.

PAUL NICKLEN

# Look Who Saw the Bigger Picture

## The winners are announced!

Thousands of fantastic entries... a world of amazing subjects... eight inspiring winning shots... one huge understanding of biodiversity... we're delighted to announce the winners of *The Green Wave* kids' photography contest – 'See the Bigger Picture'.

### A world of amazing connections

Aircraft manufacturer Airbus is determined to help protect biodiversity. It encourages everyone to take responsibility and take action. That's why it's supporting the United Nations Environment



The judges considered composition, creativity and relevance to biodiversity. They included Joel Sartore,

National Geographic photographer, renowned for photographing endangered species to highlight the problems of biodiversity loss. "The spectacular variety of life on Earth keeps our planet healthy and balanced. When we lose species we lose connections and that can trigger chain reactions. In parts of the world, for example, bees have vanished so people have to hand-pollinate vegetables with feathers. Our children will inherit a world rich – or poor – in biodiversity based on how much we preserve and protect today."



### USA & Canada winner 'Ecolife'

*"This photo was taken at the National Arboretum. Its relevance to biodiversity is that amphibians, such as frogs, are endangered but they are a very important part of an ecosystem."*

**Prerona Kundu,**  
age 11, USA



### USA & Canada winner 'Banana Slug Dining'

*"This banana slug was at our campsite in Redwood National Park. They are important to the environment as they eat decomposing material (and raspberries!) and help to fertilize the soil."*

**Anthony Avellano,**  
age 12, USA

### See the bigger picture yourself

The lucky winners are visiting the National Geographic Society's landmark headquarters in Washington, D.C.

They will meet Joel Sartore for expert photo tips first-hand before attending an exclusive gala event.

Twenty honorable mentions are also receiving National Geographic goody bags.

Take a look at all these exciting entries on:

[www.seethebiggerpicture.org](http://www.seethebiggerpicture.org)



### 'Orang Utan'

*"The baby of Orang Utan is hungry and needs love."*

**by Vinzent Raintung,**  
age 8, Germany

### Airbus winners



### 'Lonely Ladybug'

*"This year we had an unusual abundance of ladybugs, which shows how sensitive the population reacts to changes of the environment."*

**by Julia Kresse, age 15, Germany**



### 'Shargacucullia Lychnitis'

*"We were walking in Aveyron when we saw this. My dad had to hold the flower for me to take the photo because of the wind."*

**by Clémence Bonnefous,**  
age 8, France

Programme's *The Green Wave*, a youth outreach and education initiative run by the Convention on Biological Diversity; *The Green Wave* encourages young people to learn about the complex variety of life on Earth and its role in building a sustainable future, so the 'See the Bigger Picture' competition asked them to take photographs that show what biodiversity means to them. The standard of entries was as impressive as the response—from the U.S. to Belgium and from the Maldives to Ecuador—the world's children showed how much they care about the planet and about their future.

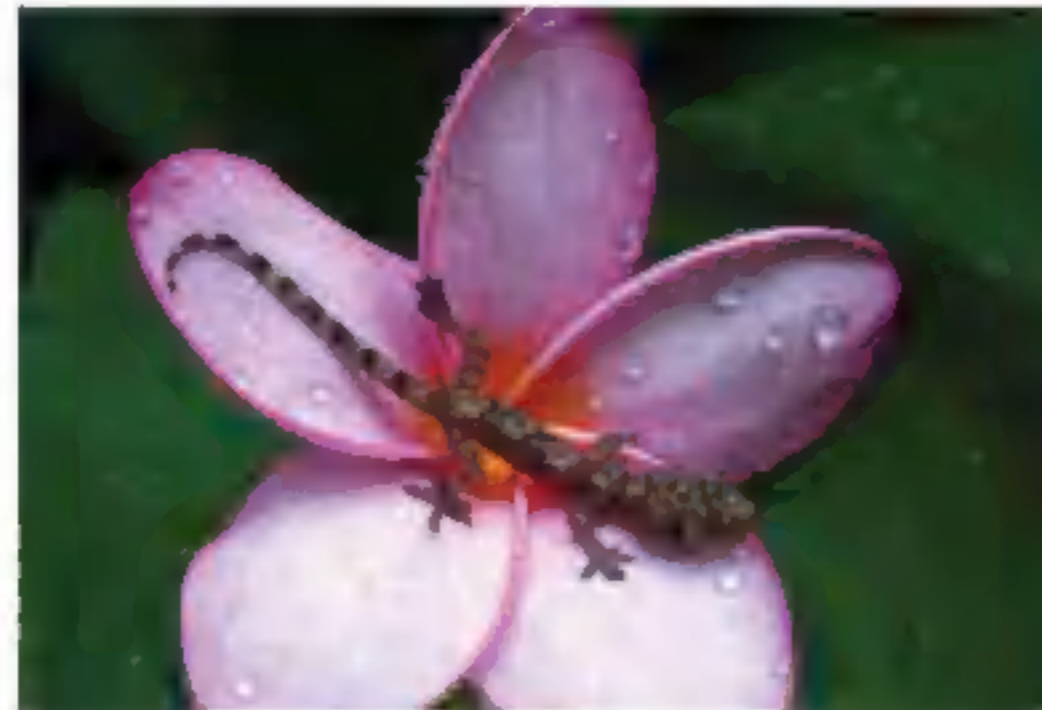


### International winner

#### 'Spirit of the Bottle'

*"Most of the people are careless and they throw all kind of trash all over the place, awful! However, this animal is a really clever one; it benefits this trash quite nifty. It has made its home in to this bottle top."*

**Alex Marttunen,**  
age 11, Finland

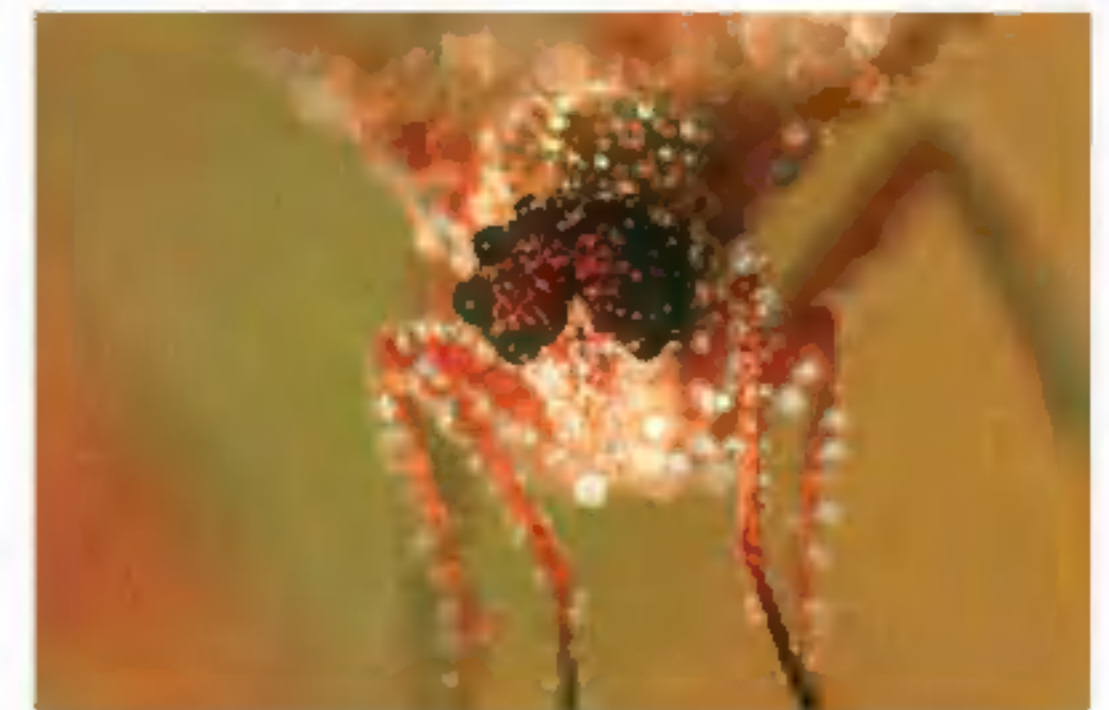


### International winner

#### 'Dominican Lizard'

*"3 colors (in 1), 2 plants, 1 life I took this in my back yard!"*

**Chad Nelson,**  
age 12, Dominican Republic



### International winner

#### 'Macroworld'

*"Macroworld is the most interesting subject of photos. We can find there the best specimens. In this picture we can see a sleepy fly with lots of drops."*

**Patryk Majchrzak,**  
age 16, Poland

# NATIONAL GEOGRAPHIC

## DEPARTMENTS

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**Visions of Earth** 10



### CULTURE

#### **Merry Krampus**

St. Nick's devilish companion is making a comeback in parts of Germany and Austria.



### GEOGRAPHY

#### **Sign Language**

Public signs reveal local color, from "sleeping policemen" to beloved bugs.

### HEALTH

#### **Fighting the Flu**

Would quarantine and isolation help in the effort to stem the H1N1 strain?

### SCIENCE

#### **Words That Last**

The terms for "I," "two," "three," "five," and "who" have been around for millennia.



### HISTORY

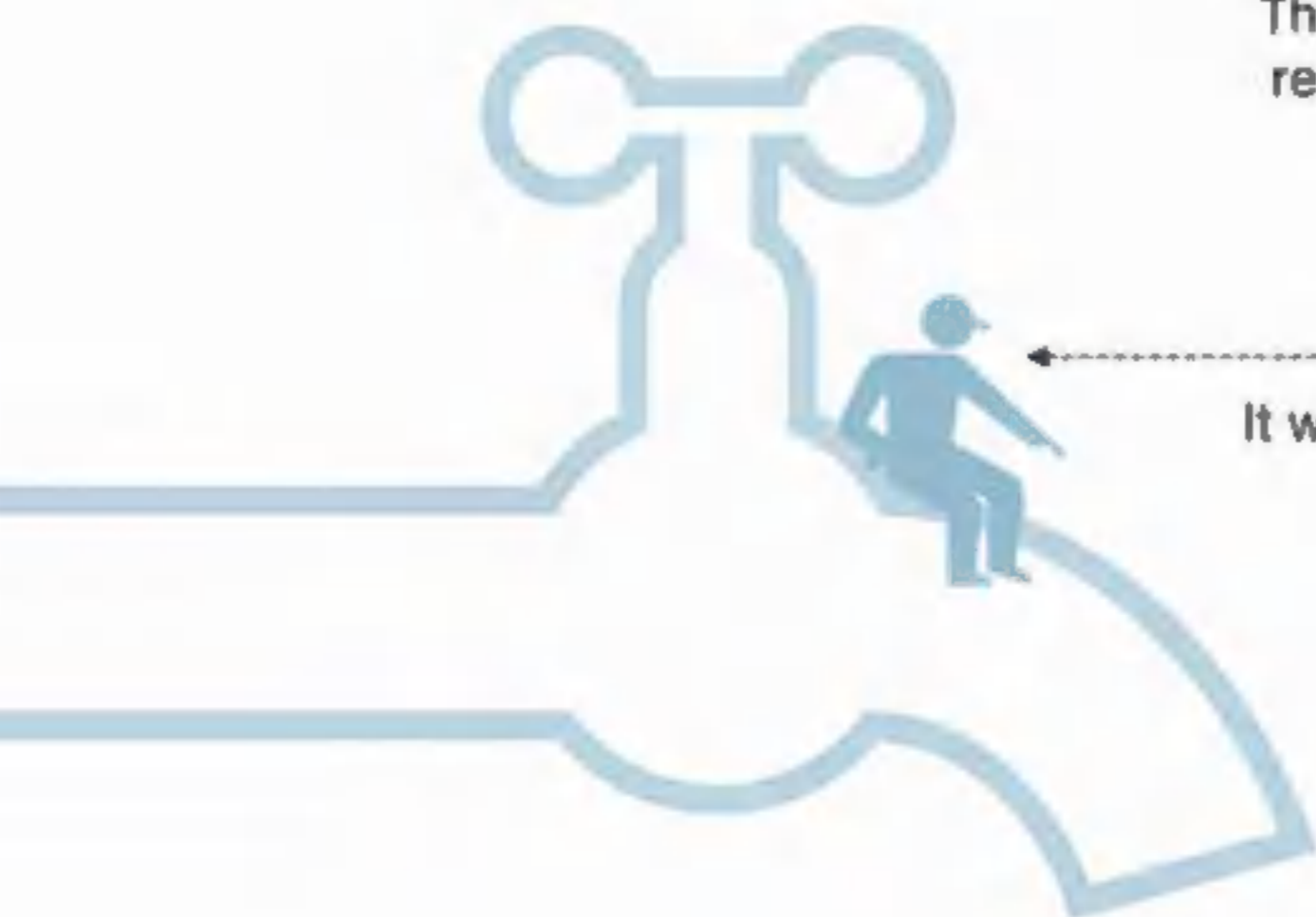
#### **Digital Scripture**

The pages of a fourth-century Bible are reunited on the Internet—scars and all.

### THE BIG IDEA

#### **The Carbon Bathtub** 26

It will take a very long time to drain excess CO<sub>2</sub> from Earth's atmosphere.



#### **Inside Geographic** 150

#### **Year in Review** 152

#### **Flashback**

#### **GeoPuzzle**

### **On the Cover**

The image of newly discovered planet Gliese 581 e is based on data showing it has about twice the mass of Earth.

*Art by Dana Berry*

[ngm.com](http://ngm.com)



#### **Best Pictures of 2009**

Take an e-stroll through galleries of the top ten photos of the year from the magazine, selected by Editor in Chief Chris Johns, as well as the ten most popular Your Shots.

JAMES NACHTWEY





**Wahnes's Parotia** (*Parotia wahnesi*)

**Size:** Head and body length, 36 - 43 cm (14.2 - 16.9 inches); wingspan, approx. 41 cm (16 inches)

**Weight:** 144 - 172 g (5.1 - 6.1 oz) **Habitat:** Mid-montane forest in a small section of the northern coastal mountain ranges of Papua New Guinea **Surviving number:** Estimated at 2,500 - 10,000



*Photographed by Tim Laman*

# WILDLIFE AS CANON SEES IT

All the world's a stage. The male Wahnes's parotia makes the most of his starring role as he performs his "ballerina dance" for an audience of females. This courtship display takes its name from the way he positions his flank plumes around his body, resembling a tutu. He simultaneously bows and fans his tail, steps side to side, shakes his feathers, and shakes his six wire-like head plumes in a flashing, iridescent spectacle. Females, meanwhile,

follow the action from a perch, sometimes fluttering or twitching their wings. But the world is getting smaller for this theatrical bird, as habitat loss steadily erodes its already limited territory.

As we see it, we can help make the world a better place. Raising awareness of endangered species is just one of the ways we at Canon are taking action—for the good of the planet we call home. Visit [canon.com/environment](http://canon.com/environment) to learn more.



Writer Matthew Teague photographed these Uygur men, advancing upon Chinese forces, moments before they were shot.

**Many people carry cameras** these days. Some have uncommon courage. On page 36 of this issue, in the story “The Other Tibet,” there is a photograph taken with a cell phone. The photographer was not a professional. She was a Uygur woman who documented the shooting of a Uygur man by Chinese security forces on a street in Urumqi, capital of China’s Xinjiang region. She later gave the picture to *National Geographic’s* photographer Carolyn Drake.

Like their Tibetan neighbors, the Uygurs have a history of struggle, but when Carolyn began covering them more than a year ago, she had no idea that the conflict would explode into one of China’s most deadly uprisings since the Tiananmen Square massacre in 1989. By June of this year, she thought her coverage was finished; she returned home to Istanbul. Then hints of unrest began to filter back to her. “At first I didn’t realize the severity of it. I started sending emails to my translator and friends in Kashgar, Hotan, and Urumqi, but no one responded.” She anxiously searched news sources, but the picture of what was going on seemed incomplete and unclear. There was only one way to find out: return to China. She did so in July.

Carolyn, writer Matthew Teague, and a Uygur woman with a cell phone camera all took great risks to bring us the story of a struggle for human rights. Many people carry cameras these days. Sometimes they help us find the truth.

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# NATIONAL GEOGRAPHIC

Inspiring people to care about the planet

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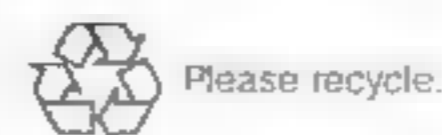
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# The Emirates Center for Wildlife Propagation

## Helping local development through the sustainable management of species



### Main achievements

- Over 44,000 houbara bred in captivity - from 165 in 1997 to 16,624 in 2009.
- Over 30,000 houbara released into the wild in Morocco.
- Large scale ecological studies - 40,000 km<sup>2</sup>, 1,500 radio-tagged birds - enabling the design of effective in-situ conservation actions.
- Hundreds of jobs created and local infrastructure upgraded by investment projects, The Promise of Sustainable Development.

The Emirates Center for Wildlife Propagation (ECWP) in Missour, Morocco, was the brainchild of Sheikh Zayed Bin Sultan Al Nahyan, late President of United Arab Emirates. A passionate conservationist, he founded the center in 1995 as part of a pioneering, visionary initiative to save and sustain the houbara bustard and preserve Arabic cultural heritage. In 2006, his strategy was secured by the Abu Dhabi Government when it created the International Fund for Houbara Conservation (IFHC), an umbrella organization for ECWP and other houbara conservation projects.

### Mission

ECWP's founding mission was to restore and conserve North Africa's native houbara bustard populations through:

- A conservation breeding program
- The restoration of natural houbara populations by releasing captive-bred birds and acting to protect the species in its natural habitat
- Sound ecological research to advance knowledge of the houbara
- Action to support local development and improve environmental education

### The promise of sustainable development

The ECWP is a genuinely integrated project that aids local development by the sustainable management of a natural resource - the houbara bustard.

The IFHC goal today is to promote ECWP's experience so that everywhere houbara and other wildlife species benefit. The practices of sustainable development can be harnessed for the good of fauna and flora - worldwide. Wild animal and plant species contribute to economic diversification and the balance of nature. And the sustainable management of species, unlike conventional farming and industry, respects ecosystems and biodiversity. ECWP - a successful example of that.

[www.ecwp.org](http://www.ecwp.org)



## THE EXPLORER'S WATCH

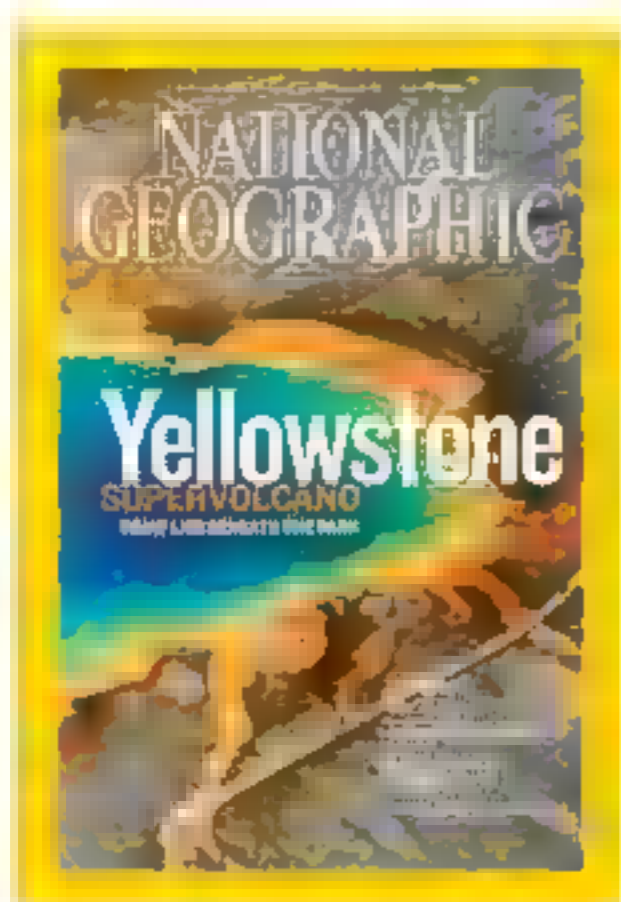
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August 2009

## Vanishing Venice

I just arrived back from Venice yesterday. Your article made me feel utterly guilty while also making me ponder the effect of tourism generally. Though Venice is a magical city, it was hard to not be distracted by the constant procession of tour groups who barged their way through the narrow streets. I felt as though I was in a pantomime and that Venice was merely a stage. The city appears to have succumbed to tourism. Some areas feel not at all genuine. The prices, while not as extortionate as in Rome, are in some cases ridiculous, with the price of a pint of beer reaching 12 euros [about \$17]. Though the response of closing Venice to deal with these problems seems clearly impossible, something serious must be done.

**SAMUEL WOOD**  
Bruton, England

After taking the vaporetto for days in Venice, nothing surprised us more than catching one at closing time for the endless amounts of tourist shops. As we squished on that boat, my teen and I could barely breathe given the amount of

people traveling. We watched as the majority of these workers disembarked to take the train out of Venice. It felt like closing time at Disneyland, with Snow White taking her wig off. There is something about visiting a place that makes it seem more authentic when you know that people really live and work there—outside of the tourist trade. Maybe this is why people can spend weeks in Rome and only a few days in Venice.

**LISA-ANN KIRK**  
Vancouver, British Columbia

You provided a wonderful sense of Venice's spirit, but I was surprised to see two fundamental issues omitted from the feature: Venice's ongoing wastewater-disposal problems and global warming's role in the increasing magnitude and/or frequency of *acqua alta* events.

**TODD ANDERSON**  
San Francisco, California

Ever notice the color of the water in Venice canals? With 21 million visitors each year and 60,000 locals, maybe there are more things to worry about than high tides.

**JOHN BATH**  
Ballina, New South Wales

My wife and I, after spending over half a century working, raising a family, and saving diligently, decided to take a postretirement "vacation of a lifetime." Guidebook in hand, we descended on Venice like a swarm of "locusts on the fields of Egypt." We had no idea we were so insensitive until we came home and read the latest bash of tourists in *National Geographic*. Until then, I did not have any more of a guilty

conscience than the waiter who charged us 30 euros [about \$44] for a Coke and a beer in the Piazza San Marco, which fortunately was not flooded at the time—perhaps because tourism was reported to be off considerably. Perhaps your editors can give us some hint as to where we thoughtless, destructive, careless tourists can share some of the privileges of your writers and photographers.

**OTIS HEADLEY**  
Oneonta, Alabama

After reading your article on tourism and its impact on the Venetian people, I would like to add that many places are suffering a similar fate. I grew up in eastern North Carolina and still live here. It's one of the fastest growing states in the country, with tourism a major industry. Along with jobs and opportunities, tourism has brought higher property taxes, traffic, the loss of wildlife habitat, poor water quality, decreased access to the water, and increases in insurance. The only alternative for some is to leave the area where they have spent their entire lives to find a cheaper place to live.

**BYRON BATEMAN**  
Farmville, North Carolina

## Corrections, Clarifications

**August 2009: Yellowstone**  
Page 68: Basaltic magma is trapped inside Yellowstone's magma chamber by less dense—not denser—overlying magma.

**Email** [ngsforum@ngm.com](mailto:ngsforum@ngm.com)

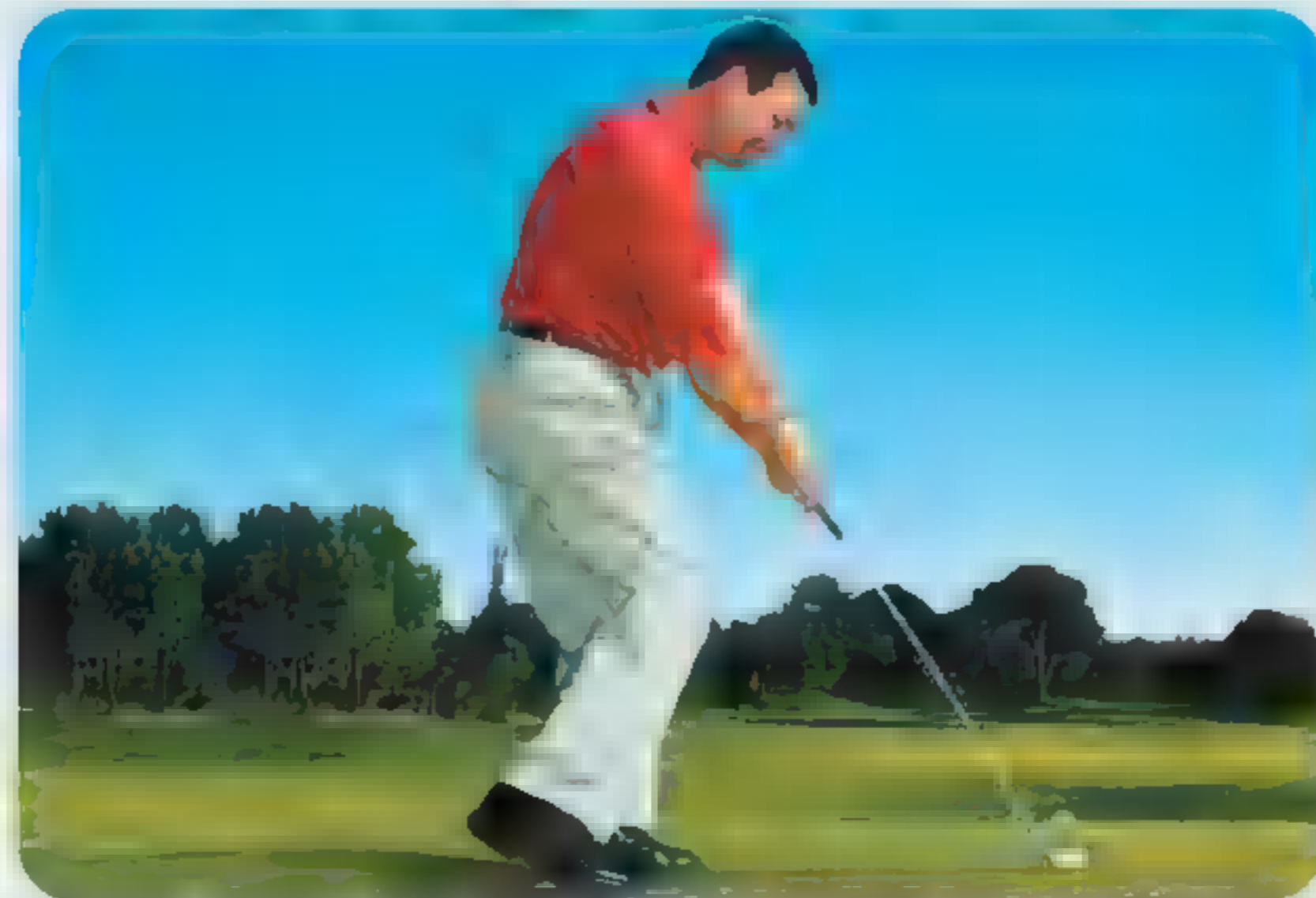
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## Full of surprises.

## LETTERS

Venice was built in the lagoon to help its residents escape invading tribes. Alas, the move was just a temporary solution, as modern marauders have overrun the place. *La Serenissima* must survive as a cultural and historical site. The regrettable loss of its inhabitants may stabilize, but only if the reality of what Venice has become is embraced and responsibly managed.

**MICHAEL PRIOR**  
Oakland, California

As an architect who has been privileged to experience Venice, I can understand the sentiment to halt its decaying grandeur from the ravages of time and tides. However, as a member of the human race, I cannot help but wonder when Mayor

Cacciari or his successors will say *abbastanza* (enough) and allow the forces of nature to take over.

**JONATHAN JEWITT**  
Glasgow, Scotland

As a Venetian, I enjoyed the article. However, I must say that I don't agree with the statement that "one thing the Venetians haven't abandoned is their cynicism." Not all Venetians are cynical. Most of us feel a deep love for our city and great respect for all our guests. Instead of cynicism, why not speak about the distinctive sense of irony that is so typical of Venetians? That is something about the Venetian philosophy of life that is never mentioned.

**ERIKA ROMBOLOTTO**  
Venice, Italy

### Under Yellowstone

Joel Achenbach's article about the Yellowstone supervolcano states that no supervolcano has erupted in recorded human history. However, New Zealanders are told that Lake Taupo, in the center of the North Island, is the collapsed caldera of a supervolcano that erupted approximately 26,500 years ago. A smaller eruption that occurred in A.D. 180 is believed to have turned the sky red over Rome and China, a phenomenon recorded at the time.

**GORDON GILLESPIE**  
Taumarunui, New Zealand

### Isn't She Lovely?

The article on camel beauty queens brought back fond memories of the ports I visited when I was deployed with the



# Welcome to Kendall

FROM THE BEST LAND COMES

U. S. Navy during Desert Storm and the liberation of Kuwait. The ship made port calls in Oman, Bahrain, Abu Dhabi, Al Fujayrah, and Dubai. The most interesting experience was a visit to a camel ranch in Bahrain. I decided to have my picture taken with a camel. My face was about a foot away from this animal who wore a huge grin. But camels spit. She let loose with a wet one—which I took right in the face. Next time *National Geographic* goes back to the Arabian Peninsula, take me with you.

**MAURY MIDDLETON, III**  
San Tan Valley, Arizona

I don't know what a really great-looking camel looks like. I thought I would find out by reading the camel pageant

story. Yet I reached the end of the story and saw nary a photo of the Miss Universe of the camel world. Sure, there were some camels shown, but no indication as to which was the beauty and which was just another beast. I think we deserved at least one shot of the belle of the ball wearing her crown, holding her scepter, and shedding the inevitable tears of a newly appointed queen.

**RICK MIGGINS**  
Toluca Lake, California

Last December I journeyed throughout the Wadi Rum desert in Jordan atop a camel. They may have been beasts of burden in ancient times. Now we are able to appreciate these gentle giants. I am surprised

that the author did not take time to ride a camel. I, on the other hand, am researching the possibility of finding a camel-riding school for next year's vacation.

**MIA VENSTER**  
Fort Lauderdale, Florida

I really have no interest in camels. However, on glancing through the article, I caught the words "beauty" and "lovely" and thought surely the author, Matthew Teague, had used the wrong words. I then had to read the entire article, which contained no condescension and no satire, and had a light touch of humor. I came away with respect for the beauty of this very functional beast.

**MARJORIE OVELMEN**  
Boca Raton, Florida

CABERNET SAUVIGNON VINEYARD  
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## LETTERS

### Kamchatka Salmon

While Kamchatka may have the first whole-basin Pacific salmon reserve, Alaska has a more advanced Sustainable Salmon Fisheries Policy. But both are under similar siege. I hope both governments will ultimately decide that "fish come first."

**GEORGE MATZ**  
Fritz Creek, Alaska

The village of Khailino may be isolated, but its residents sure make an effort to keep in touch with the rest of the world. I noticed an interesting detail in the picture on pages 48-9. Behind the lineup of microwave dishes, a huge array of yagi antennas can be seen. This

means that this may be the home of a radio amateur who communicates worldwide with fellow hams by bouncing his radio transmissions off the moon (known as Earth-Moon-Earth, or EME). Due to highly sophisticated equipment and special technical and operational know-how, less than one percent of the world's radio amateurs are able to operate in this mode.

**ERNST C. WILLERT**  
Niederkassel, Germany

### The Big Idea: Shading the Earth

As a dermatologist, I'm all for sunscreens. But launching trillions of sun-deflecting disks

into space to combat global warming? I think most folks would call this unconscionable cosmic litter, the scope of which is simply beyond sanity. Changing human behavior means preaching less personal, institutional, and political greed. A competitive society equates success with acquisition and growth. Living within means, with an eye toward simple sustainability and with respect for the Earth? We need to go there: as families, as a country, and as a global community.

**LISA A. PAWELSKI**  
Pittsburgh, Pennsylvania

This may sound like a good idea, but what are we going to

do when we need to get rid of the reflectors because of an impending ice age?

**BILL MOULTON**  
Port St. Lucie, Florida

Bad idea. We can't even begin to clean up the space junk already around Earth. Of course, parking billions of reflectors somewhere like the inner Lagrangian point may sound slyly techy, but it could also interfere with the way we measure and learn about solar emissions, particularly storms that could kill our astronauts, damage our communications satellites and GPS, and fry our electrical grid. Intelligent use of what we already have on Earth is the wise way forward.

**A. CANNARA**  
Menlo Park, California

If a cloud of reflectors is implemented to reduce the use of fossil fuels, what will we use to heat our homes on this cooler Earth? The cloud will reduce the effectiveness of solar energy, making it even more expensive. Cooler temperatures and less light will also reduce vegetation, reducing the biomass available for biofuels, not to mention food for the world's population. What's the big idea?

**TIM AND JUDY NELSON**  
Jamestown, Tennessee

I was surprised that your article did not even mention ocean acidification, the evil twin of climate change. While it is true that there may be schemes to temporarily mask increasing temperatures, they will do

nothing to combat the problem of increasingly acidic oceans. About a third of our carbon dioxide emissions is absorbed by the oceans, making them more acidic. As ocean acidity increases, many species are threatened, especially those that build shells and skeletons out of calcium carbonate, such as corals, oysters, and mollusks. In fact, some scientists predict that coral reefs could be extinct by the end of the century if we do not reduce our carbon dioxide emissions. So, while geoengineering fixes like the one in your article might seem like an easy solution to this problem, the only true solution is to mitigate our carbon dioxide emissions.

**ELLYCIA HARROULD-KOLIEB**  
Washington, D.C.

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EDITORS' CHOICE

**Ivan Dobrev** Sofia, Bulgaria

Dobrev usually takes nature pictures, but this time his job offered a window on the world. While building an industrial hall, the 32-year-old carpenter framed a stepladder, a colleague, and a dazzling burst of bright sky.

**Melissa Fiene** Sydney, Australia

Ten feet down in the blue Coral Sea, jacks and a jellyfish swim in sync. Capturing the "calm and surreal" sight was Fiene, 24, a marketer training to be a dive master. "I love the abstract nature of the underwater world," she says.



READERS' CHOICE

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**Worlds Away** Sorting through the hundreds of reader photographs submitted to Your Shot every day, we don't hear echoes—we see them. That silhouette of a proper Russian lady makes us think of that smoke-wreathed Indian holy man; a Berber's unfurled turban calls to mind the shot of an Israeli boy walking past an arrow scrawled on a door. Especially as we look at the pictures of people sent in from all over the world, similarities emerge.

Sometimes we find the echoes resonating in the subjects' actions, or in the rhythmic pattern of the photos' backgrounds. Sometimes it's something more subtle. We hope you'll see the echoes in the images on the following pages and that they make you want to look a little closer. —Margaret G. Zackowitz



**Katerina Evseyeva** Yakutsk, Russia

The autumn light, a bowl of apples, and her mother's shadow on the kitchen wall inspired Evseyeva, a 28-year-old NGO director, to pick up her camera while the two of them drank tea.



**Soma Shekar** Hyderabad, India

On a road trip with friends, "we chanced upon a small temple in Vishakhapatnam, India," says Shekar, 29, a software engineer. This sadhu "was enjoying his smoke, lost in his own world."





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**Véronique Fleury**  
Montreal, Quebec

"I took this picture while I was on a trek in the Sahara desert," says Fleury. From a vantage point atop a dromedary camel, "I turned around just in time to see our guide tying his turban."

**Jill Schneider**  
San Francisco, California

While traveling in Israel a year ago, Schneider, 27, who is pursuing a master's degree in photography, caught this Israeli boy walking in Jerusalem near the Western Wall.

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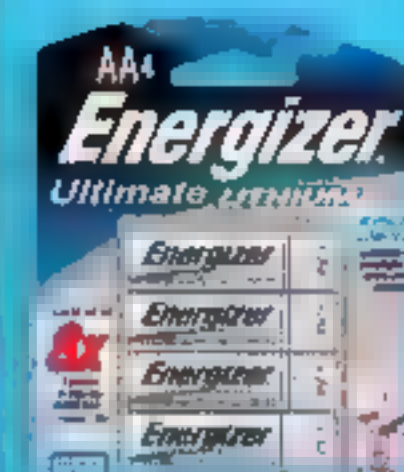
Houston, TX



*"One photo so captured the essence of the category it was entered in that I ultimately chose it as the grand-prize winner. That photo is of the courageous bicycle rider forging ahead into the storm. I have no idea what sort of storm this rider faced, but the photographer drew on every creative tool available to produce an image that captured the heart of the theme. Inspiration • Keep Going."*

**Jim Richardson**, National Geographic photographer and  
judge of the Energizer Ultimate Photo Contest

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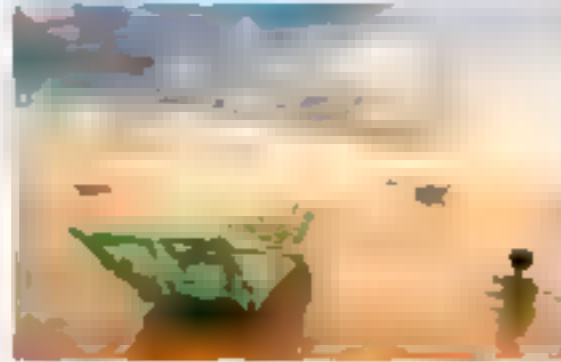
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Center Line, MI



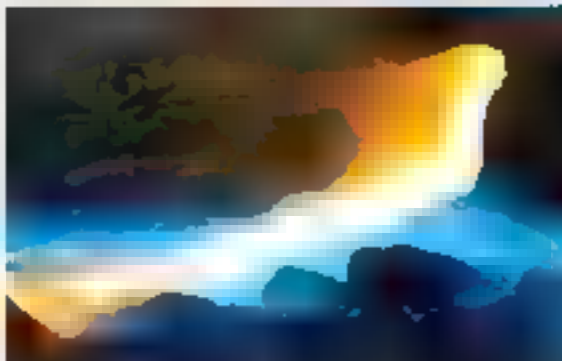
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**RUSTON AGTE**  
Tucson, AZ



NATURE

**TRACY HAGEN**  
La Selva Beach, CA



THINGS

**GLENN TRAYER**  
Haverhill Township, PA



## AND THE WINNER IS...

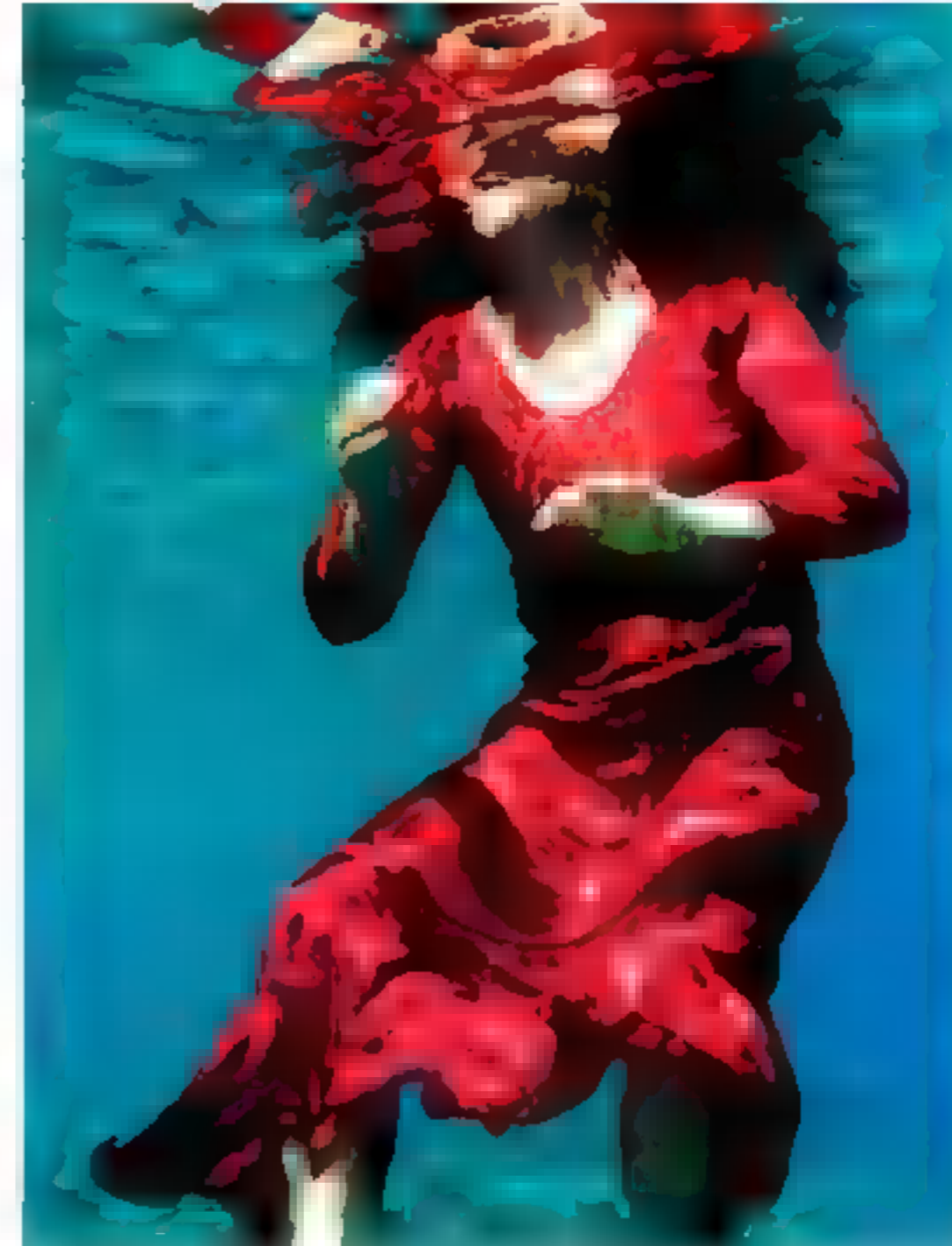
In the end, it was up to internationally acclaimed photographer, Jim Richardson, to select the grand-prize winner from this remarkable group of first-place finalists. Turn the page to see his selection and find out who's going on a 10-day National Geographic Expeditions trip for two to the Galápagos Islands.

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## YOUR SHOT | PEOPLE



**Gabriel Rif**  
Eilat, Israel

Likely wearing a dress to preserve her modesty, the woman swimming in the Red Sea shallows "was on par with all the other colorful creatures of the coral reef," says Rif, 38, who works as an underwater photographer for a diving center.



**Melissa Speelman**  
Cincinnati, Ohio

Her new underwater camera housing got a workout this summer at the local pool, claims art teacher Speelman, 39. While her four-year-old son Owen "has always loved the water," she says, "after seeing photographs of himself underwater, I think he sprouted gills."



Liam Neeson, UNICEF Supporter, actor

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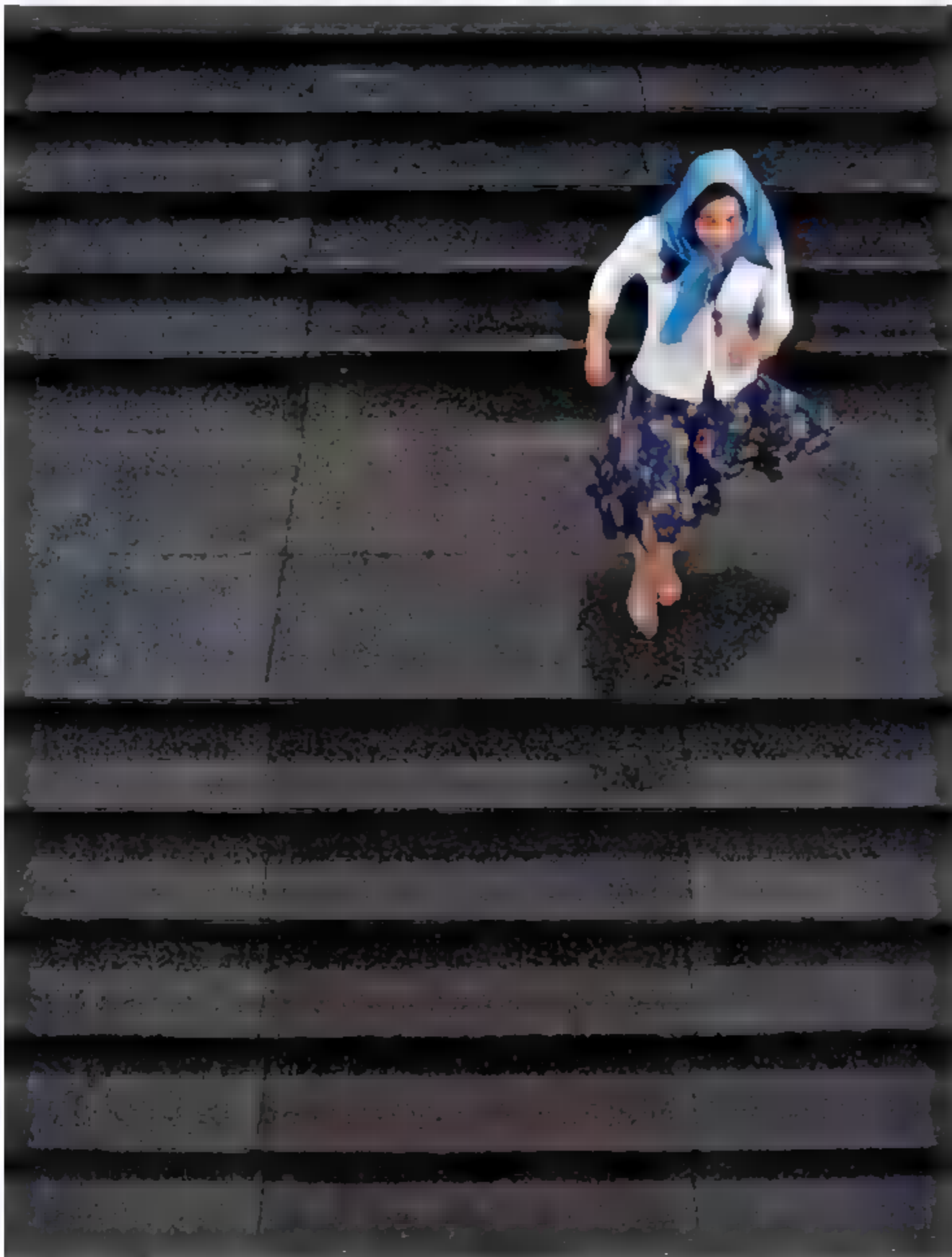
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**Mat Zain Abdullah**  
Petaling Jaya, Malaysia

Looking down from a balcony at the national mosque in Kuala Lumpur, the 38-year-old bank employee saw this woman leaving the building and got this shot.

**Bruno Schlumberger**  
Ottawa, Ontario

The stripes of artist Raymond Moretti's "La Cheminée" shimmer behind a businessman in the section of Paris called La Défense. Schlumberger, 60, was born in France but works as a photojournalist in Canada.



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**Kylie Peterson**

Orem, Utah

Peterson, a 19-year-old dietetics major at Brigham Young University, caught her little brother Jens blue-footed in the act of playing hopscotch. "Give him a piece of chalk and a sidewalk, and he will be happy for hours," she says.

**Pramod Bansode**

Panvel, India

Monsoon winds steal the umbrella of boys playing in the rain—which stole the attention of Bansode, a dental surgeon. He snapped the shot outside the village of Kolkha in India's Maharashtra state.



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VISIONS OF EARTH



**Japan** Covered in chrome and gleaming neon, big rigs from across Japan shine at a truck show in Aichi Prefecture. Known as *dekotora*, most are working trucks—though on long hauls, they're typically not driven with all their lights on.

PHOTO: ROGER SNIDER



**Antarctica** Cliffs higher than a hundred feet mark the edge of the Ross Ice Shelf, a glacier-fed slab the size of France connected to the Antarctic coast. Fissure lines near the edge show where the next iceberg may calve.



PHOTO: DAVID BARR



**Kosovo** In the village of Donje Ljubinje, local tradition calls for painting a bride's face to ward off bad luck. After the ceremony, women from her new husband's family washed Rasima Biljibani's face clean.



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It can resurface as Shingles, a painful, blistering rash. The Shingles rash usually lasts up to 30 days, and for most the pain lessens as the rash heals. But some people who develop Shingles experience long-term pain that can last for months, even years.

### **ZOSTAVAX is the only vaccine that can prevent Shingles.**

ZOSTAVAX is used to prevent Shingles in adults 60 years of age or older. Once you reach age 60, the sooner you get vaccinated, the better your chances of protecting yourself from Shingles. ZOSTAVAX is given as a single shot. ZOSTAVAX cannot be used to treat Shingles once you have it. Talk to your health care professional to see if ZOSTAVAX is right for you.

### **Important Safety Information**

ZOSTAVAX may not fully protect everyone who gets the vaccine. You should not get ZOSTAVAX if you are allergic to any of its ingredients, including gelatin and neomycin, have a weakened immune system, take high doses of steroids, or are pregnant or plan to become pregnant. Possible side effects include redness, pain, itching, swelling, warmth, or bruising at the injection site, as well as headache. You are encouraged to report negative side effects of prescription drugs to the FDA. Visit [www.fda.gov/medwatch](http://www.fda.gov/medwatch) or call 1-800-FDA-1088. Before getting vaccinated, talk to your health care professional about situations you may need to avoid after getting ZOSTAVAX. Please see the Patient Product Information on the adjacent page.

Before you get **Shingles**, ask about ZOSTAVAX.

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You should read this summary of information about ZOSTAVAX\* before you are vaccinated. If you have any questions about ZOSTAVAX after reading this leaflet, you should ask your health care provider. This information does not take the place of talking about ZOSTAVAX with your doctor, nurse, or other health care provider. Only your health care provider can decide if ZOSTAVAX is right for you.

**What is ZOSTAVAX and how does it work?**

ZOSTAVAX is a vaccine that is used for adults 60 years of age or older to prevent shingles (also known as zoster).

ZOSTAVAX contains a weakened chickenpox virus (varicella-zoster virus).

ZOSTAVAX works by helping your immune system protect you from getting shingles. If you do get shingles even though you have been vaccinated, ZOSTAVAX may help prevent the nerve pain that can follow shingles in some people.

ZOSTAVAX may not protect everyone who gets the vaccine. ZOSTAVAX cannot be used to treat shingles once you have it.

**What do I need to know about shingles and the virus that causes it?**

Shingles is caused by the same virus that causes chickenpox. Once you have had chickenpox, the virus can stay in your nervous system for many years. For reasons that are not fully understood, the virus may become active again and give you shingles. Age and problems with the immune system may increase your chances of getting shingles.

Shingles is a rash that is usually on one side of the body. The rash begins as a cluster of small red spots that often blister. The rash can be painful. Shingles rashes usually last up to 30 days and, for most people, the pain associated with the rash lessens as it heals.

**Who should not get ZOSTAVAX?**

You should not get ZOSTAVAX if you:

- are allergic to any of its ingredients.
- are allergic to gelatin or neomycin.
- have a weakened immune system (for example, an immune deficiency, leukemia, lymphoma, or HIV/AIDS).
- take high doses of steroids by injection or by mouth.
- are pregnant or plan to get pregnant.

You should not get ZOSTAVAX to prevent chickenpox.

Children should not get ZOSTAVAX.

**How is ZOSTAVAX given?**

ZOSTAVAX is given as a single dose by injection under the skin.

**What should I tell my health care provider before I get ZOSTAVAX?**

You should tell your health care provider if you:

- have or have had any medical problems.
- take any medicines, including nonprescription medicines, and dietary supplements.
- have any allergies, including allergies to neomycin or gelatin.
- had an allergic reaction to another vaccine.
- are pregnant or plan to become pregnant.
- are breast-feeding.

Tell your health care provider if you expect to be in close contact (including household contact) with newborn infants, someone who may be pregnant and has not had chickenpox or been vaccinated against chickenpox, or someone who has problems with their immune system. Your health care provider can tell you what situations you may need to avoid.

**What are the possible side effects of ZOSTAVAX?**

The most common side effects that people in the clinical studies reported after receiving the vaccine include:

- redness, pain, itching, swelling, warmth, or bruising where the shot was given.
- headache.

The following additional side effects have been reported in general use with ZOSTAVAX:

- allergic reactions, which may be serious and may include difficulty in breathing or swallowing. If you have an allergic reaction, call your doctor right away.
- fever.
- rash.
- swollen glands near the injection site (that may last a few days to a few weeks).

Tell your health care provider if you have any new or unusual symptoms after you receive ZOSTAVAX.

**What are the ingredients of ZOSTAVAX?**

Active Ingredient: a weakened form of the varicella-zoster virus.

Inactive Ingredients: sucrose, hydrolyzed porcine gelatin, sodium chloride, monosodium L-glutamate, sodium phosphate dibasic, potassium phosphate monobasic, potassium chloride.

**What else should I know about ZOSTAVAX?**

Vaccinees and their health care providers are encouraged to call 1-800-986-8999 to report any exposure to ZOSTAVAX during pregnancy.

This leaflet summarizes important information about ZOSTAVAX.

If you would like more information, talk to your health care provider or visit the website at [www.ZOSTAVAX.com](http://www.ZOSTAVAX.com) or call 1-800-622-4477.

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He was a  
hardworking farm boy.

She was an  
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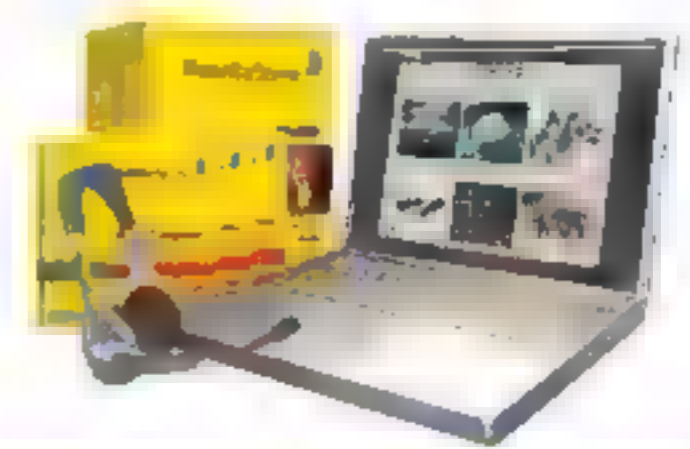
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Animal horns adorn Krampus costumes worn during pre-Christmas revelry in Munich, Germany.

**HOLIDAY THREAT**

On this vintage card Krampus is St. Nicholas's driver. Switches in the quiver were meant to keep bad kids in line.



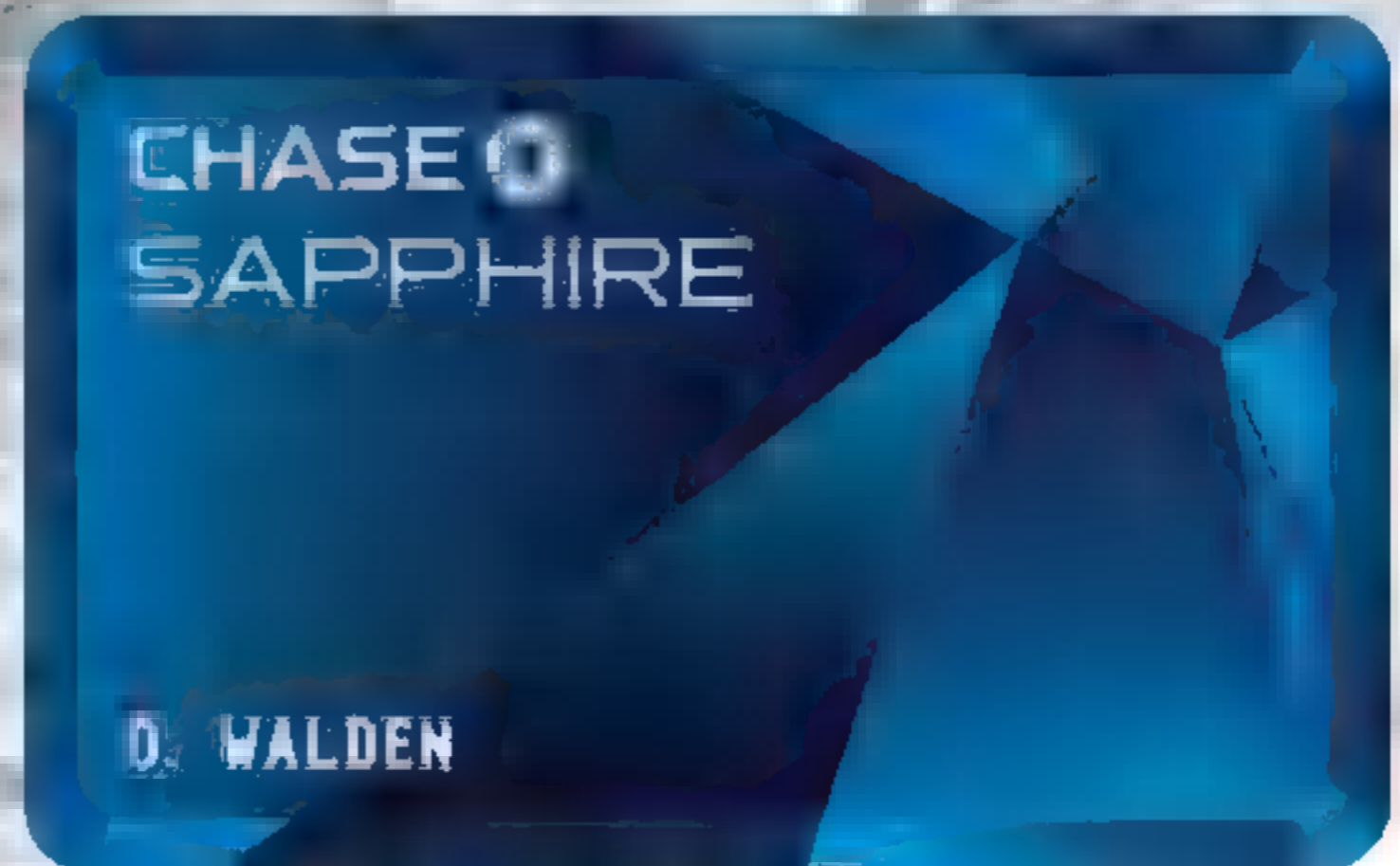
**Merry Krampus?**

A wild Christmas character is making a devilish comeback. Krampus gets his name from a word for "claw." That's apt for a demon said to grab naughty children and stuff them in his sack. Popular in Alpine villages centuries ago, Krampus scared kids straight—his long red tongue upped the fear factor—and taught them that evil bows before good. He served Santa's forerunner, kindly St. Nicholas, who had "the power to send Krampus back to hell," says Austrian ethnologist Ulrike Kammerhofer-Aggermann.

Europe once had a roster of Christmas rascals like Krampus, many with pagan roots. And Yule was a lot like today's Halloween, partly because farmers had time off from chores and could party with abandon. On December 5, the eve of St. Nick's feast day, folks would bang on doors for food and drink.

But by the 1800s, church leaders had marginalized Krampus. Now he's enjoying a mini-revival, mainly for the fun of it. The Austrian state of Salzburg alone has 180 Krampus clubs, more than half set up since 1990, says Josef Moser, Jr., chairman of Austria's Krampus Museum. Revelers roam streets in Krampus garb, rattle bells, and roar. "It feels good!" says Moser. Alas, some drink, brawl, even riot—frightening kids and adults alike. —Marc Silver

# Is it a coincidence that blackout dates fall during school vacations?



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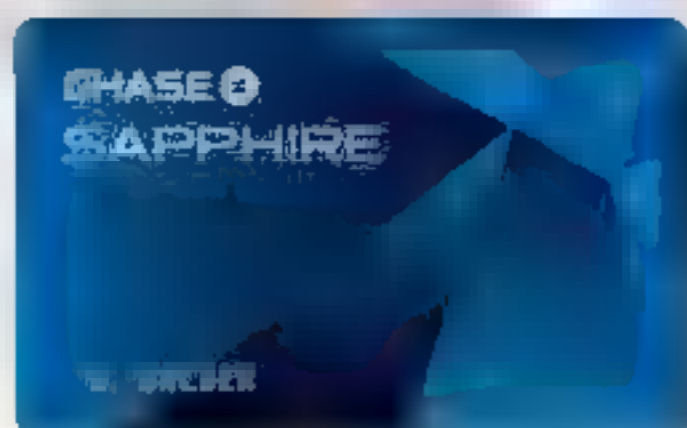
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**Everglades National Park and Biscayne Bay** ★ First, go deep into the Everglades on an airboat and see exotic wildlife up close. Next, drive through beautiful Miami on your way to Bayside Marina. Board the Biscayne Bay boat for a professional tour past Miami's spectacular coastal sites.

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Sail above Orlando and see a spectacular sunrise from the comfort of your hot air balloon. See from above all of the theme parks, orange groves, and forests, and then toast your memorable experience with a glass of champagne.

### Fantasia Snorkel Sea Safari ★

The Fantasia Snorkel Sea Safari is a world of fun for the whole family! Snorkel, slide, and rock climb all on this amazing 72-foot double deck catamaran, the only one of its kind in the Caribbean.

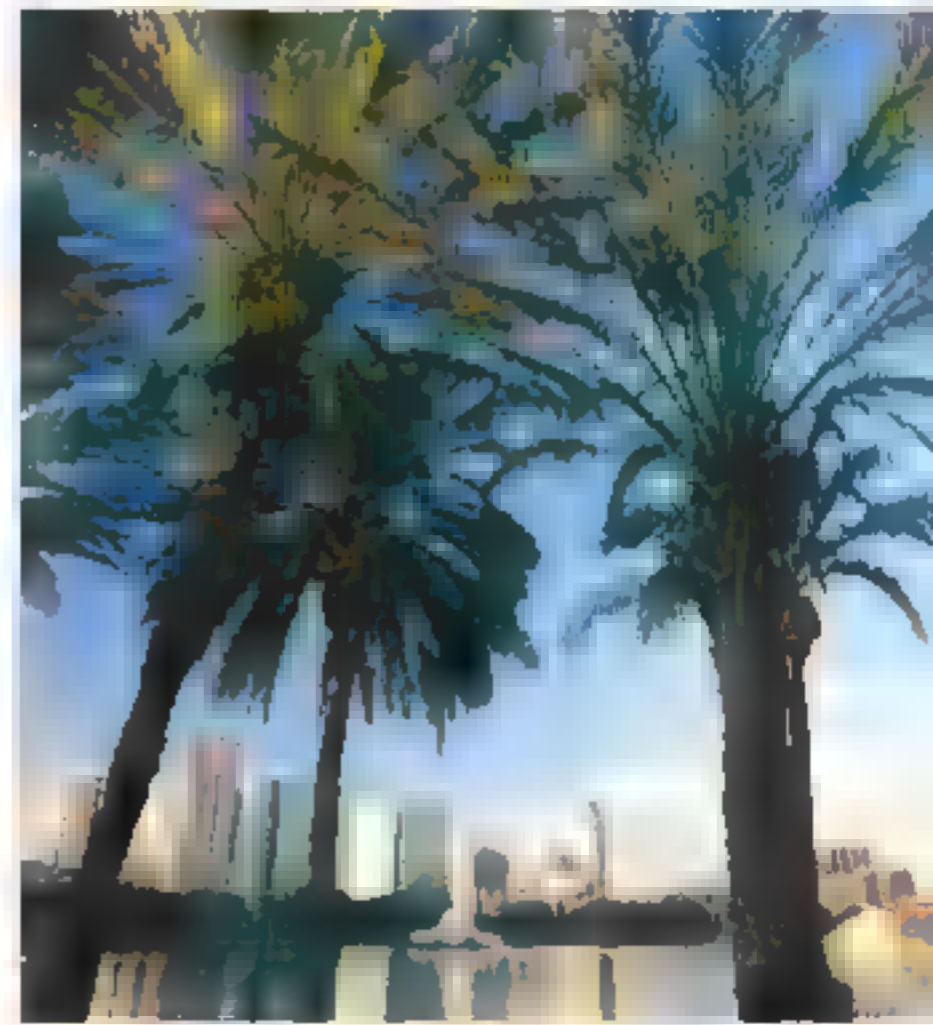
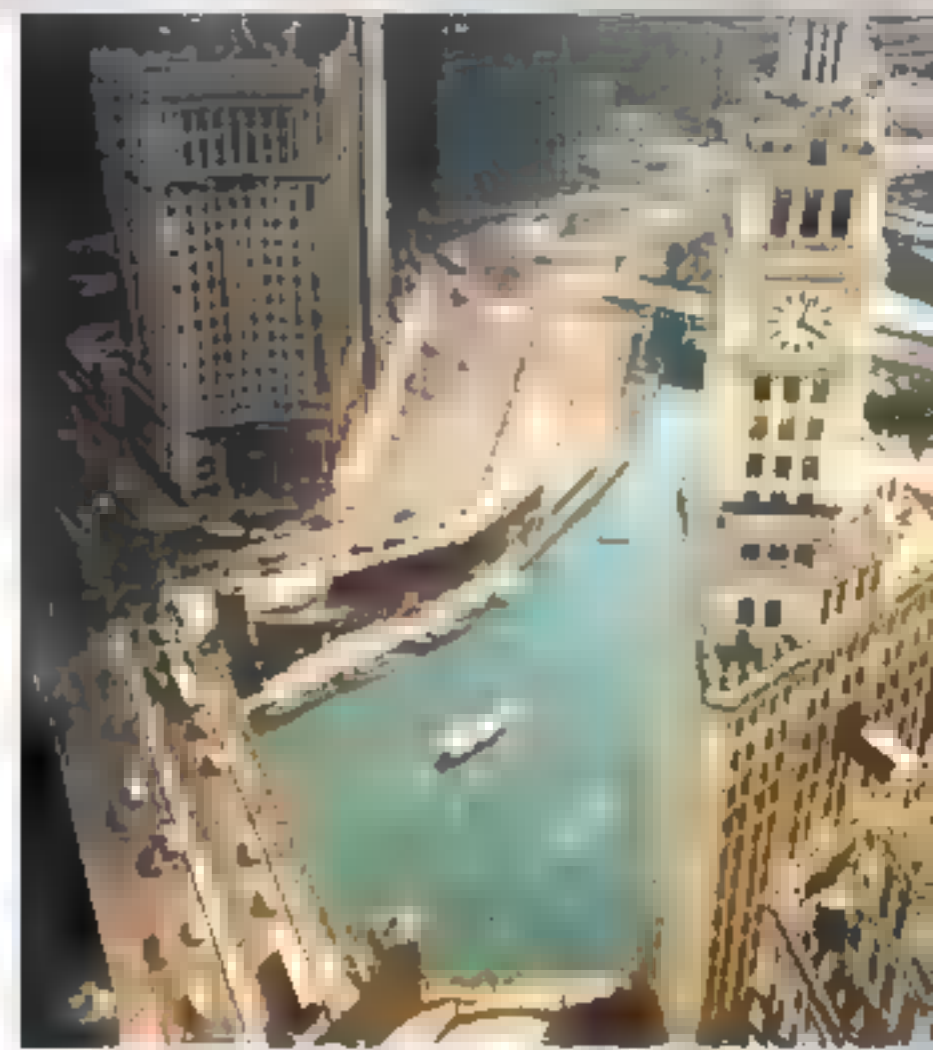
**Miami Sunset Air Tour ★** See the sun descend amidst dazzling colors while on this magnificent air tour over Miami. Be sure to bring your camera and capture the sky's transition from late afternoon gold and amber to the brilliant red hues of sunset.

**New Orleans Steamboat Natchez Evening Jazz Cruise ★** Jazz is the heartbeat of New Orleans and there's no better way to feel the city's pulse than by taking this evening cruise. Board the Steamboat Natchez and hear the Grammy nominated 'Dukes of Dixieland' for a truly memorable experience.

**Nashville's Grand Legends Tour ★** Get your country music fix with this tour through Nashville's music scene. See the Grand Ole Opry and Opryland Hotel as well as the Willie Nelson Museum. Finish your day with a stroll along the Country Music Sidewalk of Fame.

### Chicago River and Lake Architecture Tour ★

Chicago is renowned for stunning and original architecture and the most relaxing way to see it is on a cruise on the Chicago River. You'll learn about Chicago's history and landmarks before taking a thrilling speedboat ride on Lake Michigan.



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**Sign Language** The perfect sign would have no words and be easy to grasp. "The rational thing is to create standard symbols everybody understands," says David Gibson, author of *The Wayfinding Handbook*. He's one of many designers the world over who work toward uniformity and understandability.

Yet the unconventional sign has undeniable allure. Doug Lansky curated "Signspotting," an exhibit that drew crowds in Stockholm and Edinburgh and is traveling to other cities. In his show and in public places, signs can entertain with overkill (No. 16, below) and fanciful images (No. 7). They also let travelers see the world through another culture's eyes. No. 20 instructs squat-toilet users in Western bathroom etiquette. Says Lansky: "Now I understand why I see footprints on the toilet in an international airport." —Marc Silver



**SIGNPOSTS** Traffic-sign expert Susan Chrysler cites studies showing that 40 to 90 percent of onlookers can't decode certain images. Here's a guide to our gallery.

- 1 **South Africa** Very steep ramp leads to crocodile pit
- 2 **United States** No swearing
- 3 **Argentina** Hands off the butterflies
- 4 **South Africa** Brake for dung beetles
- 5 **Germany** No public peeing
- 6 **France** No unleashed dogs
- 7 **Ireland** Sudden drop-off
- 8 **Australia** Speeding endangers cassowaries
- 9 **United States** Beware RV mirrors
- 10 **France** A ski lift how-to
- 11 **Canada** Don't eat shellfish
- 12 **Jamaica** Britishism for speed bump
- 13 **Canada** Logs in water may shift in storm
- 14 **Brazil** Some seats on bus reserved for obese riders
- 15 **Austria** No sledding (the red circle can mean "don't")
- 16 **Switzerland** Skiers beware
- 17 **South Africa** Unauthorized vendors can't sell food
- 18 **Canada** Avalanche danger
- 19 **U.K.** Old folks crossing
- 20 **Cambodia** Toilet etiquette



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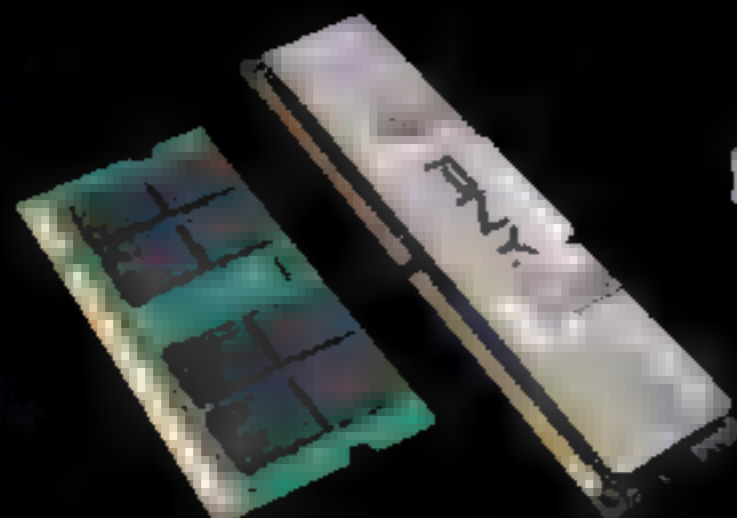


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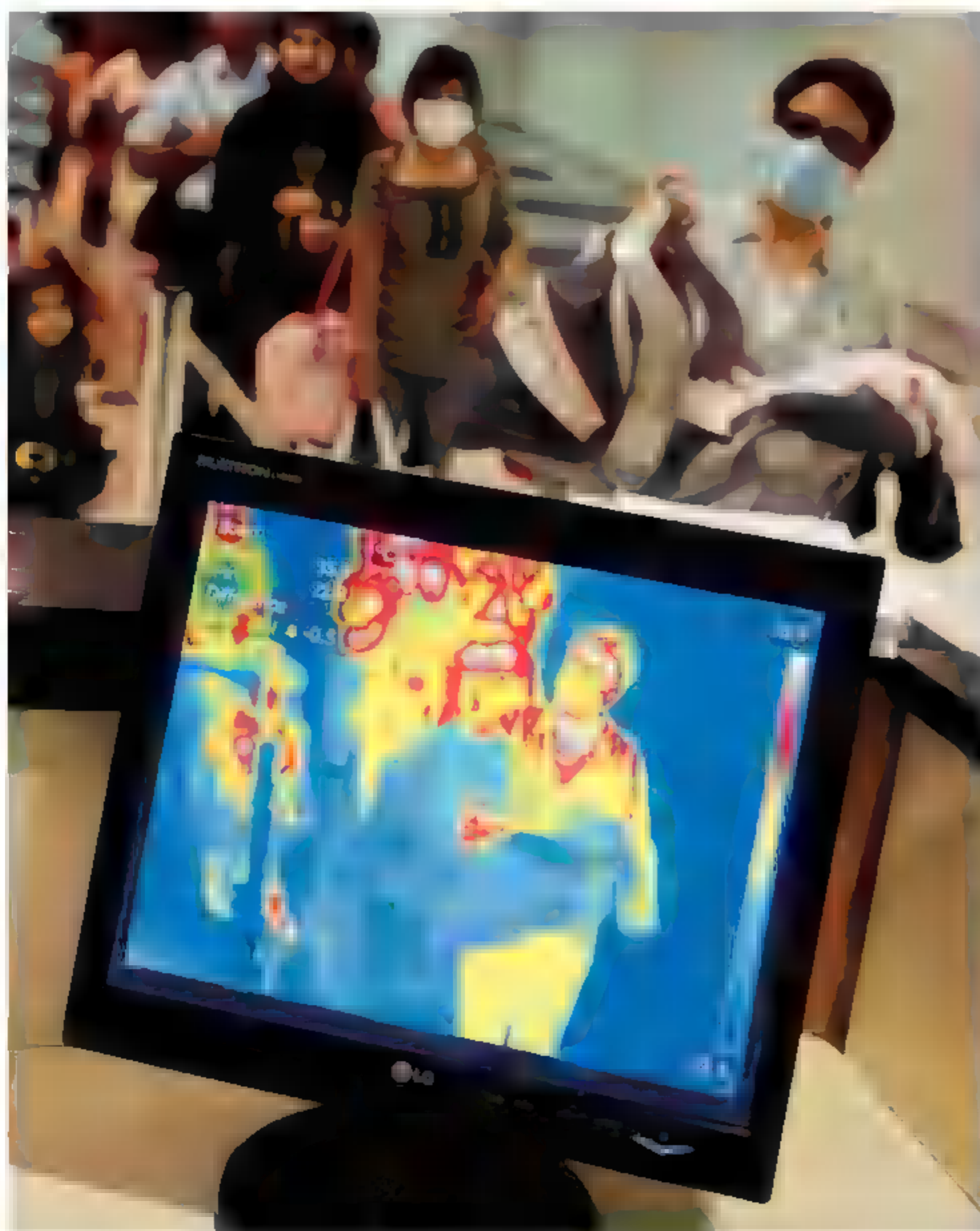
STAPLES



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Passengers are screened at ■ Beirut airport during the swine flu outbreak.

**Fighting the Flu** Last summer, public health experts warned that 2009 H1N1, aka swine flu, could afflict up to 50 percent of the U.S. population this flu season. To prepare, officials readied 50 million doses of initial vaccines for children, pregnant women, and health care workers. Though not likely, two other, older techniques— isolation and quarantine—could also eventually be considered.

Isolation separates sick people from well ones. Quarantine limits the movements of those who aren't ill but have been exposed. In lieu of ■ vaccine, these intrusive, oft-debated measures can curb disease spread, lower death rates, and lessen the toll on hospitals.

Both are "social distancing" tacks. School closures are another. For all, coordination and timing are key. Act too soon, and the costs can outweigh the health benefits; one study says 26 weeks of shuttered U.S. schools could mean lost wages equal to 6 percent of the GDP. Act too late, and more people can die as the virus's attack rate grows. Yet well-timed action can help. In the 1918 flu pandemic, the cities that fared the best—San Francisco, St. Louis, Kansas City, Milwaukee—acted fast and on many fronts. —Melody Kramer

## A BRIEF GLOBAL HISTORY OF PUBLIC-HEALTH CONFINEMENTS

**CIRCA 600-400 B.C.** The Torah offers instructions on isolating lepers and disinfecting the home.

**A.D. 549** The emperor Justinian isolates travelers from disease-affected regions during a plague.

**1374** In an era of plague, ships must lie at anchor for 40 days ("quaranta" in Italian, ergo "quarantine") prior to docking in Venice.

**1892** After typhus fever strikes, Eastern European Jewish immigrants are sent to the same New York island that will later confine Typhoid Mary.

**1893** The U.S. National Quarantine Act allows the federal government to enforce containments.

**1900** San Francisco's quarantine of Chinatown is ruled discriminatory.

**1963** A smallpox carrier is quarantined, the last U.S. confinement until a TB patient is isolated in 2007.

**2003** SARS joins plague, smallpox, yellow fever, and tuberculosis on the U.S. quarantine list.

**2009** Lacking an H1N1 vaccine, nations kill pigs, prohibit gatherings, and ban flights from Mexico.

Truly  
Unique



## Rock Around the Clock Tonight

Standing in front of the guitar shop window was the greatest thrill and the worst kind of torture. As a kid, I never had the money to shell out for a mint condition Gibson, Rickenbacker or Les Paul. But they were right there in front of me, lined up like lacquered, mahogany and maple trophies. I could stare for hours at the smooth curves, long necks and the occasional flourish of mother-of-pearl. But I was stuck admiring them from outside, through glass like some kind of museum display.

After playing for what seemed like an eternity on dinged-up secondhanders, I finally got my first Fender Stratocaster. It was worth the wait. I slid it over my shoulder, plugged in and cranked out my best version of "Pipeline." The guitar looked and felt like a masterpiece. That's the thing about a classic guitar, the work of art is the piece you play...and the piece itself.

It's no wonder then that this remarkable Stauer Guitar Watch instantly plucked at my heartstrings. One look at its voluptuous body brought me right back to the glory days of rock-and-roll.

The unique shape immediately brings to mind those round-bottomed bodies of vintage electric guitars. The same classics strummed by Bill Haley, Buddy Holly and true guitar gods like Jimi, Eric and Keith.

The eye-catching, ivory face features blue Roman numerals on the left of the dial and bold Arabic numbers on the right. Blued, Breguet-style hands keep time while additional complications mark the day, date and month. A date window sits at the 3 o'clock position. Inside, the 27-sapphire-jewel movement utilizes an automatic self-winding mechanism that never needs batteries. The Stauer Guitar Watch secures with a genuine black leather band and is water-resistant to 3 ATMs.

A quick word of caution—I've been wearing the guitar watch for weeks and it has significant side effects. "Chuck Berry's Greatest Hits" has been stuck in my car stereo. I find myself humming Bo Diddley during conference calls and once in a while I take a slow ride past the guitar shop on my way home.

If you aren't fully impressed by the

performance and stage presence of the Stauer 6-String within 30 days, simply return the watch for a full refund of the purchase price. The unique design of the 6-String limits our production to only 4,995 pieces, so don't hesitate to order! Sorry, no Wah Wah pedal included!

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**AS THE WORD TURNS** The five words in the center are the oldest of the 200 below and have changed least over time. Those closest to the edge have evolved more quickly, vary more between languages, and tend to be younger.



**New Word Order** The graphic on this page isn't "refrigerator poetry." It's a landmark study of 87 related languages found in Europe, the Middle East, and the Indian subcontinent. Linguists knew these 200 words (English versions above) shared a 9,000-year-old Mesopotamian ancestry, yet until now couldn't predict which ones would change over time, which ones wouldn't, and why.

But when University of Reading evolutionary biologist Mark Pagel fed the list into a computer, he found the secret of verbal life: Use it or lose it.

Words employed most often in daily speech, such as "I," are the oldest and most stable; their forms or sounds may date back over 10,000 years. Words used the least may be replaced within 800 years. And parts of speech change at different rates.

So will local lingo be homogenized in this age of global media? Not necessarily, says Pagel, citing stiff British resistance to "couch" for "sofa." And though words may be mutable, concepts are not. An old-fashioned value judgment like "bad" will simply find new expression. —Jeremy Berlin

# The World is Our Stage



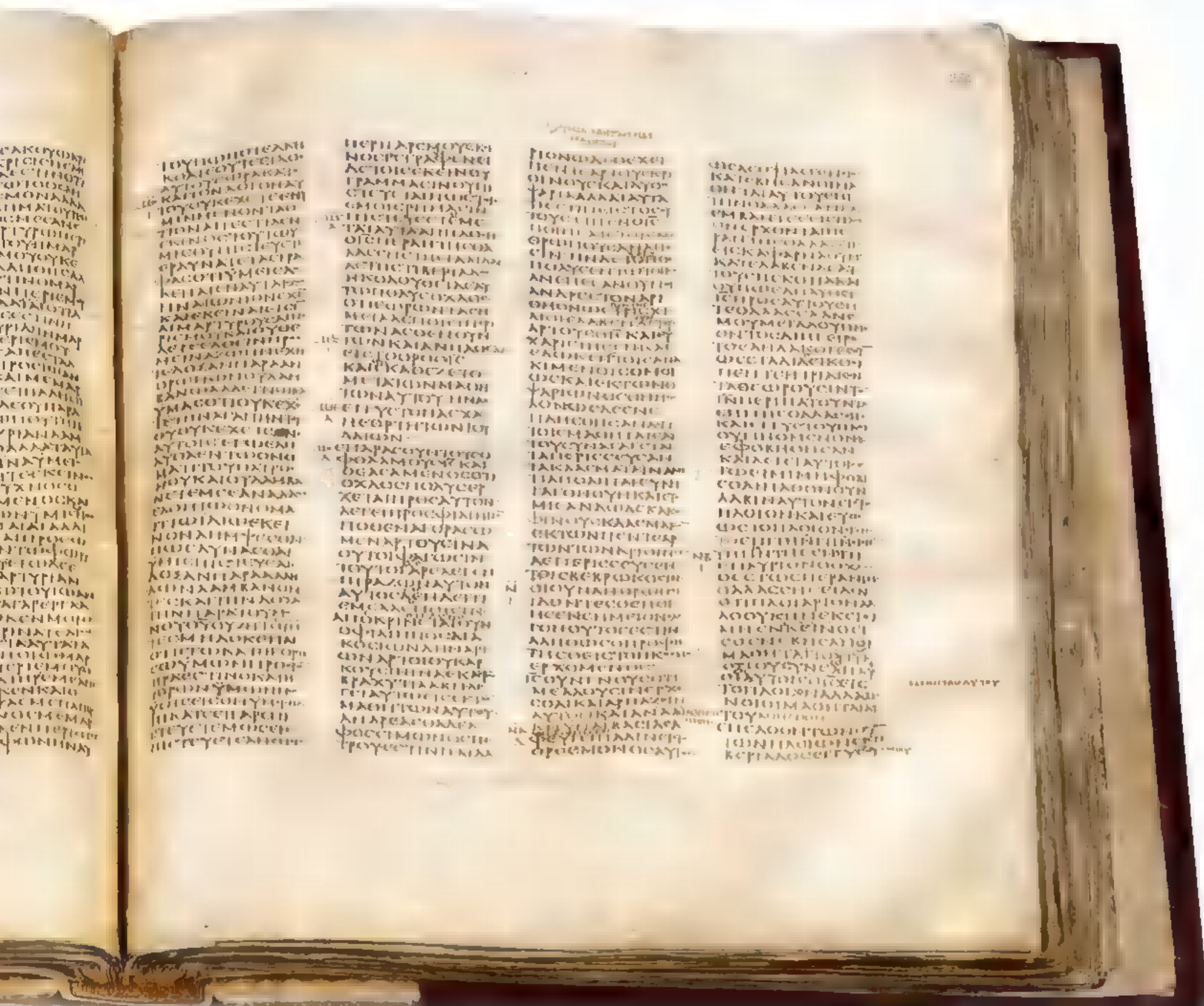
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# HISTORY



**Digital Scripture** A fourth-century Bible that includes the earliest known complete copy of the New Testament now has a 21st-century address: [codexsinaiticus.org](http://codexsinaiticus.org). For much of its existence, the sacred text—handwritten on parchment in ancient Greek—resided at St. Catherine’s Monastery in the Sinai, from which it takes its name. As with many old manuscripts, it was eventually split up, and some of it was lost. Only 823 of an estimated 1,487 pages survive.

The virtual archive reunites what remains at the monastery with parts in England, Germany, and Russia. Each page appears in high definition along with a catalog of details. This lets scholars easily study features such as additions and corrections made until the 12th century, when the text was deemed outdated. Says the British Library’s Juan Garcés, who’s leading the four-year digitization effort, “It was alive for a long time.” And now it lives again. —A. R. Williams



A scar from an animal’s hide (above) marks one of the 694 bound pages of parchment (top) housed at the British Library in London.

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VYTORIN is the only product that helps block cholesterol that comes from food and reduces the cholesterol your body makes naturally, based on family history. And VYTORIN can dramatically lower your bad cholesterol 45%–60%. (Average effect depending on dose; 52% at the usual starting dose.)

VYTORIN contains two cholesterol medicines, *Zetia* (ezetimibe) and *Zocor* (simvastatin), in a single tablet. **VYTORIN has not been shown to reduce heart attacks or strokes more than *Zocor* alone.**

**Ask your doctor if VYTORIN is right for you.** Or, to learn more, call **1-877-VYTORIN** or visit **vytorin.com**.



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**Important Risk Information About VYTORIN:** VYTORIN is a prescription tablet and isn't right for everyone, including women who are nursing or pregnant or who may become pregnant, and anyone with liver problems.

Unexplained muscle pain or weakness could be a sign of a rare but serious side effect and should be reported to your doctor right away. VYTORIN may interact with other medicines or certain foods, increasing your risk of getting this serious side effect. So tell your doctor about any other medications you are taking.

Your doctor may do simple blood tests before and during treatment with VYTORIN to check for liver problems. Side effects included headache, muscle pain, and diarrhea. You are encouraged to report negative side effects of prescription drugs to the FDA. Visit [www.fda.gov/medwatch](http://www.fda.gov/medwatch), or call 1-800-FDA-1088.

**Please read the more detailed information about VYTORIN on the adjacent page.**

**VYTORIN<sup>®</sup>**  
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**Treat the 2 sources of cholesterol.**

## **VYTORIN® (EZETIMIBE/SIMVASTATIN) TABLETS PATIENT INFORMATION ABOUT VYTORIN (VI-tor-in)**

Generic name: ezetimibe/simvastatin tablets

Read this information carefully before you start taking VYTORIN. Review this information each time you refill your prescription for VYTORIN as there may be new information. This information does not take the place of talking with your doctor about your medical condition or your treatment. If you have any questions about VYTORIN, ask your doctor. Only your doctor can determine if VYTORIN is right for you.

### **WHAT IS VYTORIN?**

VYTORIN is a medicine used to lower levels of total cholesterol, LDL (bad) cholesterol, and fatty substances called triglycerides in the blood. In addition, VYTORIN raises levels of HDL (good) cholesterol. VYTORIN is for patients who cannot control their cholesterol levels by diet and exercise alone. You should stay on a cholesterol-lowering diet while taking this medicine.

VYTORIN works to reduce your cholesterol in two ways. It reduces the cholesterol absorbed in your digestive tract, as well as the cholesterol your body makes by itself. VYTORIN does not help you lose weight. VYTORIN has not been shown to reduce heart attacks or strokes more than simvastatin alone.

### **WHO SHOULD NOT TAKE VYTORIN?**

Do not take VYTORIN:

- If you are allergic to ezetimibe or simvastatin, the active ingredients in VYTORIN, or to the inactive ingredients. For a list of inactive ingredients, see the "Inactive ingredients" section at the end of this information sheet.
- If you have active liver disease or repeated blood tests indicating possible liver problems.
- If you are pregnant, or think you may be pregnant, or planning to become pregnant or breast-feeding.
- If you are a woman of childbearing age, you should use an effective method of birth control to prevent pregnancy while using VYTORIN.

VYTORIN has not been studied in children under 10 years of age.

### **WHAT SHOULD I TELL MY DOCTOR BEFORE AND WHILE TAKING VYTORIN?**

**Tell your doctor right away if you experience unexplained muscle pain, tenderness, or weakness. This is because on rare occasions, muscle problems can be serious, including muscle breakdown resulting in kidney damage.**

The risk of muscle breakdown is greater at higher doses of VYTORIN.

The risk of muscle breakdown is greater in patients with kidney problems.

Taking VYTORIN with certain substances can increase the risk of muscle problems. It is particularly important to tell your doctor if you are taking any of the following:

- cyclosporine
- danazol
- antifungal agents (such as itraconazole or ketoconazole)
- fibric acid derivatives (such as gemfibrozil, bezafibrate, or fenofibrate)
- the antibiotics erythromycin, clarithromycin, and telithromycin
- HIV protease inhibitors (such as indinavir, nelfinavir, ritonavir, and saquinavir)
- the antidepressant nefazodone
- amiodarone (a drug used to treat an irregular heartbeat)
- verapamil (a drug used to treat high blood pressure, chest pain associated with heart disease, or other heart conditions)
- large doses ( $\geq 1$  g/day) of niacin or nicotinic acid
- large quantities of grapefruit juice ( $>1$  quart daily)

It is also important to tell your doctor if you are taking coumarin anticoagulants (drugs that prevent blood clots, such as warfarin).

Tell your doctor about any prescription and nonprescription medicines you are taking or plan to take, including natural or herbal remedies.

Tell your doctor about all your medical conditions including allergies.

Tell your doctor if you:

- drink substantial quantities of alcohol or ever had liver problems. VYTORIN® (ezetimibe/simvastatin) may not be right for you.
- are pregnant or plan to become pregnant. Do not use VYTORIN if you are pregnant, trying to become pregnant or suspect that you are pregnant. If you become pregnant while taking VYTORIN, stop taking it and contact your doctor immediately.
- are breast-feeding. Do not use VYTORIN if you are breast-feeding.

Tell other doctors prescribing a new medication that you are taking VYTORIN.

### **HOW SHOULD I TAKE VYTORIN?**

- Take VYTORIN once a day, in the evening, with or without food.
- Try to take VYTORIN as prescribed. If you miss a dose, do not take an extra dose. Just resume your usual schedule.
- Continue to follow a cholesterol-lowering diet while taking VYTORIN. Ask your doctor if you need diet information.
- Keep taking VYTORIN unless your doctor tells you to stop. If you stop taking VYTORIN, your cholesterol may rise again.

### **WHAT SHOULD I DO IN CASE OF AN OVERDOSE?**

Contact your doctor immediately.

### **WHAT ARE THE POSSIBLE SIDE EFFECTS OF VYTORIN?**

See your doctor regularly to check your cholesterol level and to check for side effects. Your doctor may do blood tests to check your liver before you start taking VYTORIN and during treatment.

In clinical studies patients reported the following common side effects while taking VYTORIN: headache, muscle pain, and diarrhea (see What should I tell my doctor before and while taking VYTORIN?).

The following side effects have been reported in general use with VYTORIN or with ezetimibe or simvastatin tablets (tablets that contain the active ingredients of VYTORIN):

- allergic reactions including swelling of the face, lips, tongue, and/or throat that may cause difficulty in breathing or swallowing (which may require treatment right away), rash, hives; raised red rash, sometimes with target-shaped lesions; joint pain; muscle pain; alterations in some laboratory blood tests; liver problems (sometimes serious); inflammation of the pancreas; nausea; dizziness; tingling sensation; depression; gallstones; inflammation of the gallbladder; trouble sleeping; poor memory.

Tell your doctor if you are having these or any other medical problems while on VYTORIN. This is not a complete list of side effects. For a complete list, ask your doctor or pharmacist.

### **GENERAL INFORMATION ABOUT VYTORIN**

Medicines are sometimes prescribed for conditions that are not mentioned in patient information leaflets. Do not use VYTORIN for a condition for which it was not prescribed. Do not give VYTORIN to other people, even if they have the same condition you have. It may harm them.

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**But let me get to the point:** his loss is your gain. Many of you may be wondering about your next gift for someone special. In the past, Stauer has made gift giving easier with the absolute lowest prices on fine jewelry and luxury goods. This year, we've really come to the rescue.

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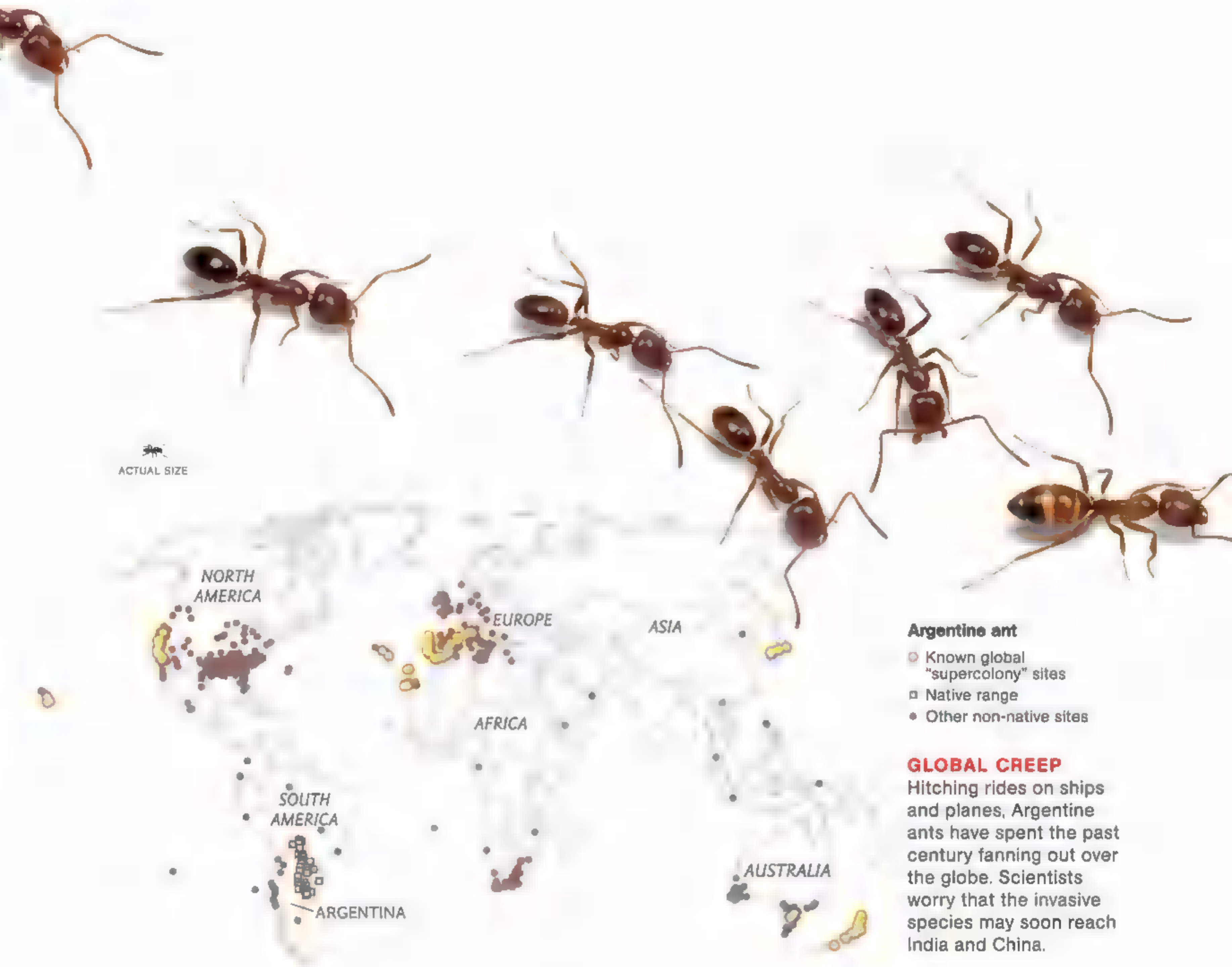
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### Argentine ant

- Known global "supercolony" sites
- Native range
- Other non-native sites

### GLOBAL CREEP

Hitching rides on ships and planes, Argentine ants have spent the past century fanning out over the globe. Scientists worry that the invasive species may soon reach India and China.

**Ants on the March** The insect version of Roman legions or Mongol raiders, Argentine ants have invaded far corners of the planet, becoming one of the world's worst pests. Crawling on every continent save Antarctica, they displace native ants, threaten crops, and terrorize homes. And now, contend some researchers, *Linepithema humile* have formed a global "supercolony"—perhaps the largest insect society ever known.

The groundwork began in earnest in the 1890s, when the small brown ant turned up in Portugal and the United States, likely having arrived on cargo ships. Adapting to numerous climates, the species is highly cooperative, says evolutionary

biologist Neil Tsutsui of the University of California, Berkeley. Instead of attacking each other, individuals from separate nests will rub antennae, share food, and tend one another's queens.

Research by Tsutsui and others attributes the Argentine ant's success in part to a genetic bottleneck that has reduced diversity and competition. Many of the insect invaders appear to be descended from a single ancestral group—one so dominant that despite oceans separating them, ant supercolonies on six continents are related, though other scientists disagree. What is agreed on: Only vigilant cargo inspections will stop the ants from ruling new lands. —Tom O'Neill

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# The Carbon Bathtub

It's simple, really: As long as we pour CO<sub>2</sub> into the atmosphere faster than nature drains it out, the planet warms. And that extra carbon takes a long time to drain out of the tub.

**What if we stop increasing emissions?**

Even at the current emissions rate, CO<sub>2</sub> is released into the atmosphere nearly twice as fast as it is removed—so the bathtub will continue to fill.

**How do we cause CO<sub>2</sub> emissions?**

Four-fifths is from burning fossil fuels. Nearly all the rest is from deforestation and other changes in land use.

**How much is too much?**

No one is sure. Some scientists think we need to reduce the CO<sub>2</sub> level back down to 350 parts per million (ppm)—equivalent to 745 billion metric tons of carbon—to avoid serious climate impacts. But if current emissions trends continue, 450 ppm will be passed well before mid-century.

**Where does our CO<sub>2</sub> go?**

Plants and soil absorb about a third each year, and ocean surface waters about a quarter. The rest stays airborne for a long time.

350 parts per million

**IN**  
**9.1**  
billion  
metric tons  
a year

**OUT**  
**5**  
billion  
metric tons  
a year

**45%** REMAINS IN ATMOSPHERE

**30%** ABSORBED BY PLANTS & SOILS

**25%** ABSORBED BY OCEANS

**< 1%** ABSORBED BY SEDIMENTS & ROCKS\*



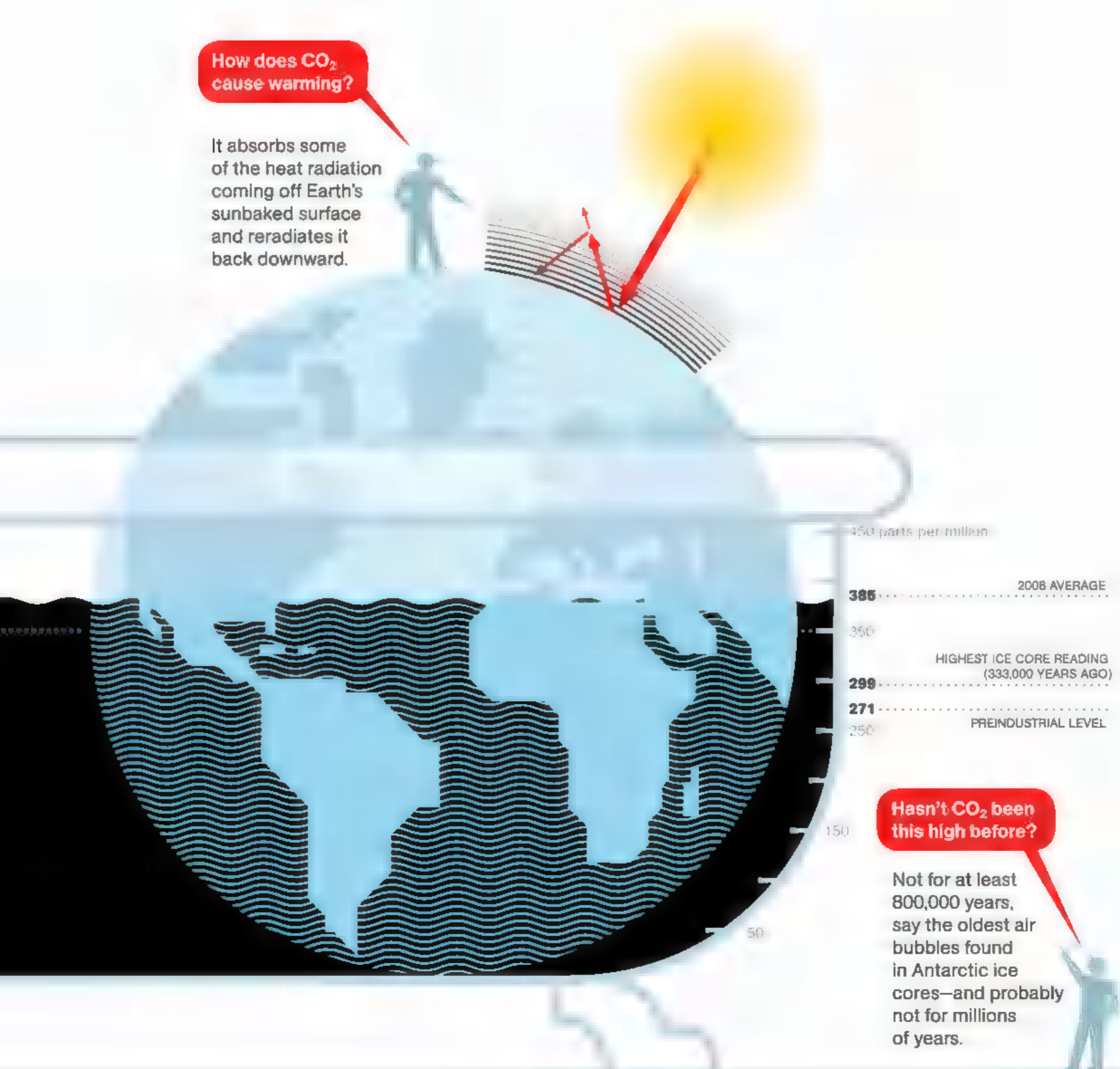
**A fundamental human flaw**, says John Sterman, impedes action on global warming. Sterman is not talking about greed, selfishness, or some other vice. He's talking about ■ cognitive limitation, "an important and pervasive problem in human reasoning" that he has documented by testing graduate students at the MIT Sloan School of Management. Sterman teaches system dynamics, and he says his students, though very

bright and schooled in calculus, lack an intuitive grasp of a simple, crucial system: ■ bathtub.

In particular, ■ tub with the tap running and the drain open. The water level can stand for many quantities in the modern world. The level of carbon dioxide in Earth's atmosphere is one. A person's waistline or credit card debt—both of which have also become spreading problems of late—are two more. In all (Continued on next page)

**How does CO<sub>2</sub> cause warming?**

It absorbs some of the heat radiation coming off Earth's sunbaked surface and reradiates it back downward.



**Hasn't CO<sub>2</sub> been this high before?**

Not for at least 800,000 years, say the oldest air bubbles found in Antarctic ice cores—and probably not for millions of years.

\*PERCENTAGES DO NOT ADD UP TO 100 BECAUSE OF ROUNDING.  
 GRAPHIC: NIGEL HOLMES. SOURCES: JOHN STERMAN, MIT; DAVID ARCHER, UNIVERSITY OF CHICAGO, GLOBAL CARBON PROJECT

As seen on National Geographic Channel's  
**THE HUMAN FAMILY TREE**  
As read in National Geographic magazine's September 2009 article  
**FROM AFRICA TO ASTORIA BY WAY OF EVERYWHERE**



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# THE BIG IDEA (continued)

RAINS FROM TUB

What if we stop emissions completely?

It will take centuries for plants and the ocean to soak up most of the human-made CO<sub>2</sub>. It will take hundreds of millennia for the rest to be removed by rock weathering, which converts CO<sub>2</sub> to carbonate sediments and rocks.



Why would the level stay high for so long?

Plants and soil absorb CO<sub>2</sub> quickly, but that reservoir fills up fast.

The deep ocean is bigger, but access is slow; CO<sub>2</sub>-laden surface water sinks at only two places near the Poles.

Carbonate sediments and rocks are far bigger and slower still; they form at sea from elements weathered off rocks on land.

PLANTS & SOIL

DEEP OCEAN

SEDIMENTS & ROCKS

three cases, the level in the tub falls only when the drain runs faster than the tap—when you burn more calories than you eat, for instance, or pay off old charges faster than you incur new ones.

Plants, oceans, and rocks all drain carbon from the atmosphere, but as climatologist David Archer explains in his book *The Long Thaw*, those drains are slow. It's going to take them hundreds of years to remove most of the CO<sub>2</sub> that humans are pouring into the tub and hundreds of thousands of years to remove it all. Stopping the rise of CO<sub>2</sub> will thus require huge cuts in emissions from cars, power plants, and factories, until inflow no longer exceeds outflow.

Most of Sterman's students—and his results have been replicated at other universities—didn't understand that, at least not when the problem was described in the usual climate jargon. Most thought that simply stopping emissions from rising would stop the rise of CO<sub>2</sub> in the atmosphere—as if a tap running steadily but rapidly would not eventually overflow the tub. If MIT

graduate students don't get it, most politicians and voters probably don't either. "And that means they think it's easier to stabilize greenhouse gases and stop warming than it is," Sterman says.

By 2008, the level of CO<sub>2</sub> in the tub was 385 parts per million (ppm) and rising by 2 or 3 ppm each year. To stop it at 450 ppm, Sterman says, ■ level many scientists consider dangerously high, the world would have to cut emissions by around 80 percent by 2050. When diplomats convene in Copenhagen this month to negotiate a global climate treaty, Sterman will be there to help, with software that shows immediately, based on the latest climate-model forecasts, how ■ proposed emissions cut will affect the level in the tub—and thus the temperature of the planet. His students are generally much better at bathtub dynamics by the end of his course, which gives him hope. "People can learn this," he says. —Robert Kunzig



**Tub Dynamics** To experiment with the effects of different emissions cuts, go to [ngm.com/bigidea](http://ngm.com/bigidea).



30 *A long journey ahead, Uyghur villagers settle in for a night ride from Darya Boyi to market.*

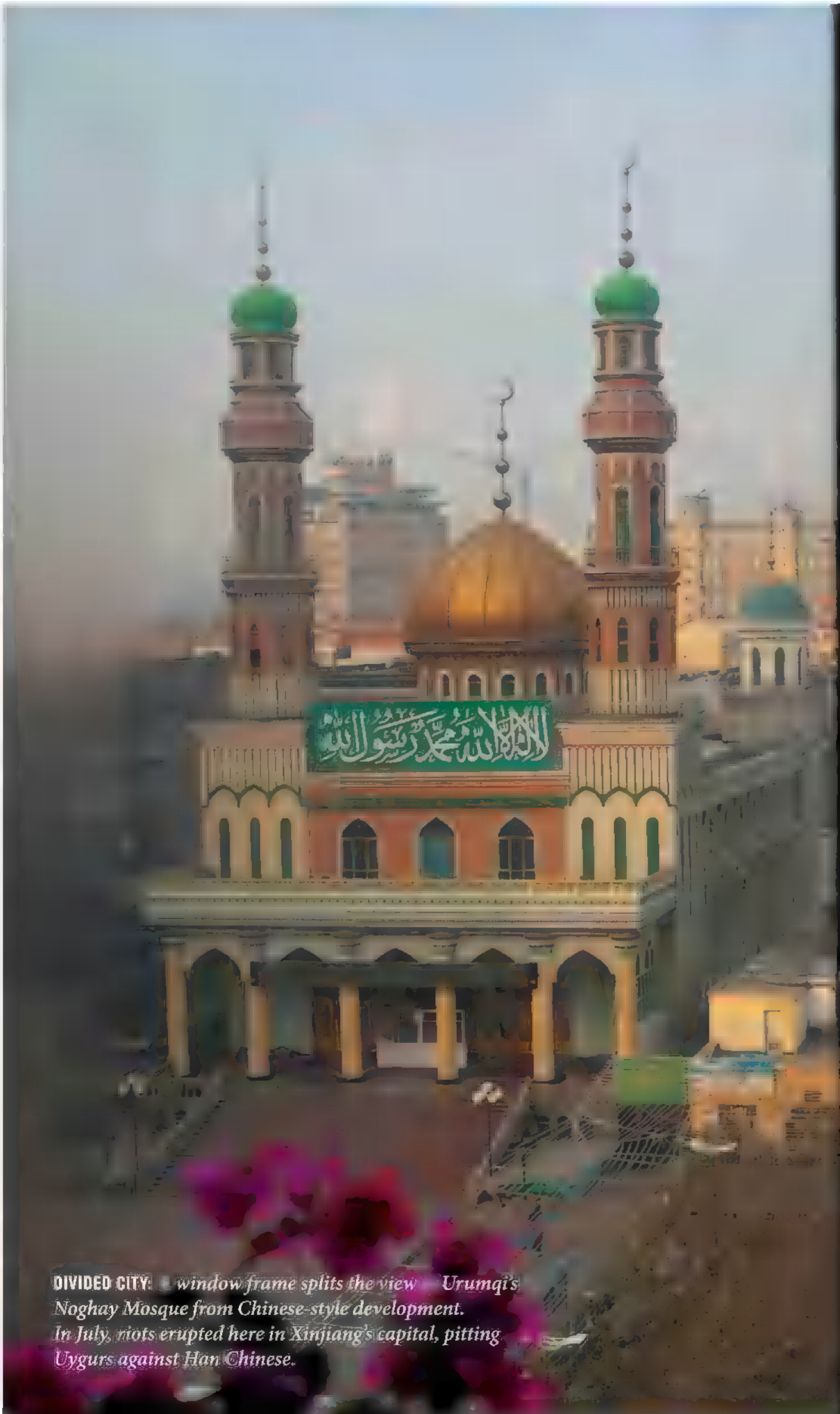




*The Uyghurs, Muslim people of China's resource-rich far west, are becoming strangers in their own land as Han Chinese pour in. Like the Tibetans, who face similar pressures, some Uyghurs see a chance for a better life, but others protest the disintegration of their culture, even at the risk of death.*

# THE OTHER TIBET

BY MATTHEW TEAGUE PHOTOGRAPHS BY CAROLYN DRAKE



**DIVIDED CITY:** • window frame splits the view • Urumqi's Noghay Mosque from Chinese-style development. In July, riots erupted here in Xinjiang's capital, pitting Uygurs against Han Chinese.





**ALONE IN A CROWD,** *Uyghur woman (at right) shops at a Chinese market in Karamay, an oil-industry city dominated by Han. Although they make up nearly half of Xinjiang's population, Uyghurs hold few top jobs.*





JULY 13, 2009

**THE FIRST SEVERAL SECONDS** of the incident in Urumqi seemed almost lighthearted, considering the previous week. And they revealed nothing about what would follow. A cool front had swept over the city on this particular day in July, drawing people from their homes. Some shops stayed closed because their windows had been shattered, but food vendors pushed their carts out onto the street. A week earlier an ethnic clash had broken out here, killing almost 200 people in one of China's most deadly protests since the Tiananmen Square massacre two decades ago. So the Chinese government had sent tens of thousands of security forces into

*Documented on a bystander's cell phone,  
a Uygur man lies in a street in Urumqi,  
shot by security forces after charging  
them with what appeared to be a sword.*

the city, the capital of the Xinjiang Uygur Autonomous Region, to restore order between the Han and the Uygurs. The Han dominate Chinese society, but the Uygurs (pronounced WEE-gurs), a Turkic-speaking Central Asian people, claim this western borderland as their ancestral home.

Han security forces stood in ranks along every street in the city's Uygur quarter. They bristled with riot gear and automatic weapons. The only sound came from loudspeakers mounted on trucks that trawled the market streets, broadcasting the good news of ethnic harmony. If Urumqi had an edge of unrest on this Monday, it was sheathed in silence.

Most Uygurs are Muslims, and about noon I stood on the street in front of a central mosque wondering how many people might be inside. As if in answer, a mass of humanity came pouring out, hundreds of people tumbling and plunging into the street.

Bystanders watched, puzzled, but the emerging crowd offered only odd and inscrutable clues: Many hadn't had time to pull on their shoes and ran in just their socks. They cried out with alarm or possibly in celebration, and their faces glowed with either fear or joy. If they were fleeing from danger, there was no sign of it, and the group split and flew north and south. In the flicker of a moment they had disappeared.

Now three men stepped from the mosque, holding what looked like wooden sticks. One wore a blue shirt, one a black shirt, and one a white shirt. They shouted and smiled, which gave their faces a buoyant quality. Their tiny rally seemed brash: Did they not see the Chinese police on every corner or hear the amplified news about manifest happiness?

They turned southward. All three walked with peculiar long strides and waved their sticks overhead, like three baton-twirling drum majors whose marching band had run ahead of them. They passed rows of market stalls where people shouted to them to stop whatever they were doing. Shop owners slammed shut their stall doors. After two blocks the men stopped and turned back north; just before they reached

me, they crossed the street. They still held up what were, more likely, rusted swords.

Once across the street, they burst into a run, heading toward a group of armed Chinese. The man in blue sprinted ahead; he seemed to catch the government forces off guard, because they turned and ran. The details of the next moment—the angle of the running man, his shirt billowing behind him, the strange coolness of the air—were etched by a sound: a gunshot. But the three Uygurs did not stop in the face of destruction. They tilted toward it.

THE TIBETAN STRUGGLE for independence from China has long captivated the West. Fewer people are familiar with an arguably more critical struggle in a neighboring hinterland: that of the Uygurs. Their anonymity is ironic because the West has played an unwitting role in their current crisis—and because the Uygurs, whose culture is fading toward obscurity, once occupied the center of the known world.

Xinjiang sits in the middle of Asia, encircled by some of Earth's highest mountains, as though a drawstring had cinched the top of the world like a coin purse. Passes through those snowy mountains funneled ancient traders and travelers along paths that became the renowned Silk Road. "They say it is the highest place in the world," Marco Polo wrote of climbing the Pamir mountains from the Afghanistan side. When he emerged from the pass, he found the Uygur homeland and marveled: "From this country, many merchants go forth about the world."

The territory became the fulcrum on which Asia and Europe balanced. Turkic raiders and later Genghis Khan, Buddhists and then Muslims, traders and tribesmen, missionaries and monks—all passed through this hemispheric crossroads, and each group left something of itself. I saw a Uygur woman wearing a Muslim head cover and holding her baby, whose head

---

*Matthew Teague wrote about camels in the August issue. From her base in Istanbul, Carolyn Drake documents the lives of people across Central Asia.*



she had shaved into phantasmagoric designs, ■ pre-Islamic shamanistic practice to frighten away baby-stealing evil spirits. Xinjiang's history is also written in the faces of its people: dark faces with oval eyes. Also fair faces with narrow, jet eyes. And sometimes blue eyes with blond hair.

Geography itself protects the mosaic of Uygur culture in Hotan, in far southwestern Xinjiang. A range of snowcapped mountains rises at the town's back, and before it lies the Taklimakan, a desert larger than Poland, which people sometimes call the Sea of Death. Hotan's inhabitants are mostly farmers, and many of them come together each Sunday outside the town for a bazaar where children eat sweetened ice shaved from chunks that float down the Karakax (Black Jade) River, women browse tents full of silk, and men gather to have their beards trimmed while they tell jokes.

It's an old scene, although there is an occasional sign of technology: Knifemakers sit in long rows on ancient bicycles they've reconfigured to spin grindstones, looking like an invading horde of spark-spitting cyclists. A young Uygur man named Otkur (the names of Uygurs in Xinjiang

have been changed for their protection) shared his bowl of sheep's lung with me, and afterward we approached an astonishing device: a two-story-high swing set with a seat big enough for two people to stand on. Otkur smiled. "For playing," he said. Two women climbed onto the ends of the seat and swung so high they disappeared into tree branches.

In town I met Dawud, a music master who teaches a small group of students. In his school a large mural showed a *mashrap*, a traditional all-male gathering—now closely regulated by the Chinese—where Uygurs convene to play music, recite poetry, and socialize. Dawud fashioned a fingerpick from a piece of wire and some twine, flicked his fingers across the five strings of a tambur, and launched into a series of complex songs with roots that reach back at least five centuries.

Those patchwork elements of Uygur life underscore something crucial about the Uygurs as a whole: Centuries of living at a great Eurasian way station have made them ■ complicated people who defy careless classification. But in time the world forgot this, with disastrous results.



**RAISING HER VOICE**, a Han teacher calls out the correct answer in Chinese at ■ Uygur high school. Despite an official bilingual policy, the Uygur language is disappearing from classrooms. Some Uygur parents want their children to learn Chinese as a way to get ahead, but many decry the stifling of language and identity. Surveillance cameras at a new Uygur housing project in Kashgar (right) reinforce Chinese control.



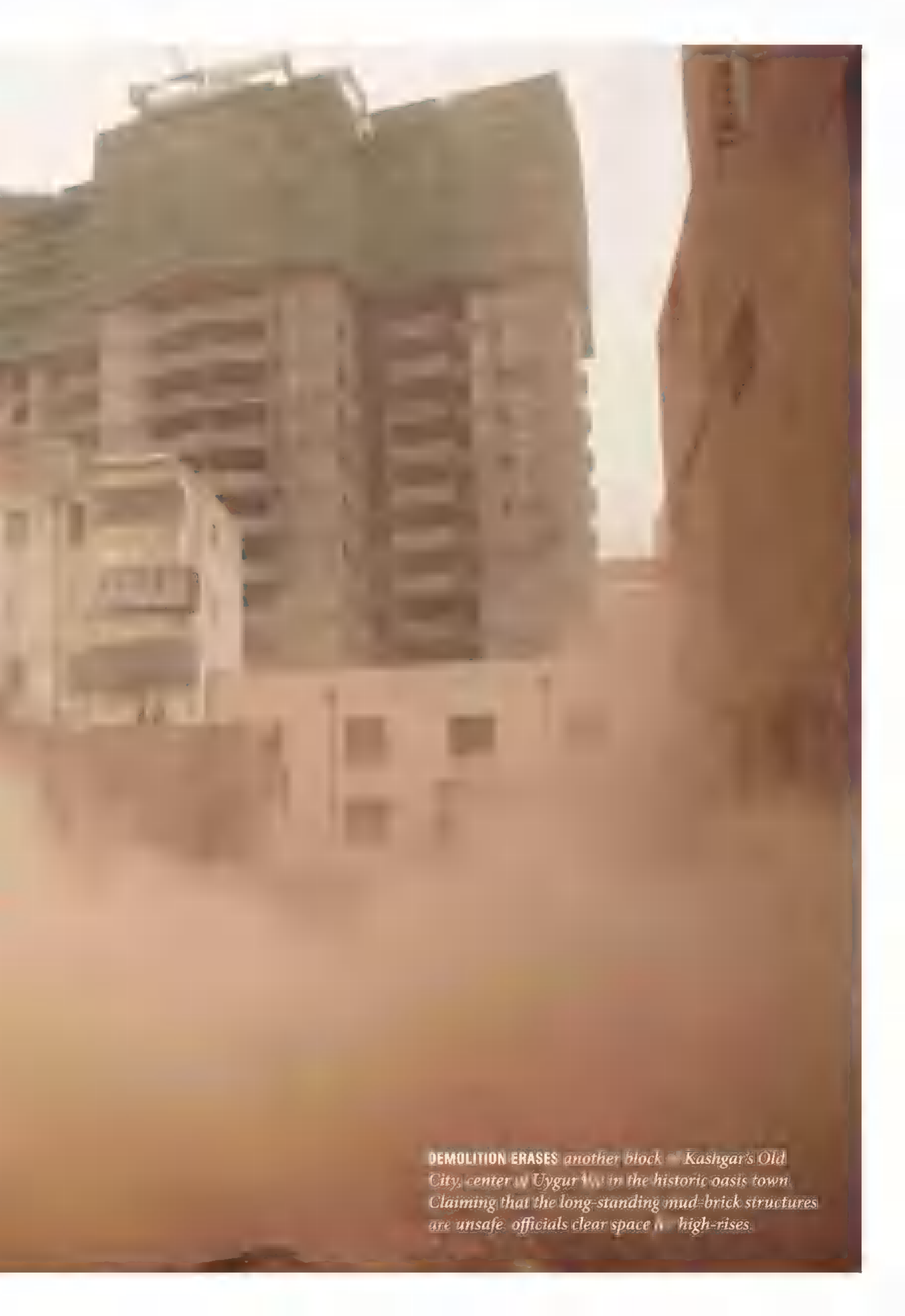
**THE CHINESE WERE DISCOVERING THAT XINJIANG OFFERED MORE THAN A BORDER CUSHION: IT HELD SOMETHING VITAL TO THEIR SURVIVAL.**

AS THE SILK ROAD began to fray and trade took to the seas, both East and West lost interest in the Uygurs and their mountain fastness. For generations China saw little promise in this remote land—Xinjiang means “new frontier”—because the Chinese prized agriculture, and the wild west offered only dust and stones. People there ate mutton, not pork. In 1932 a British officer traveling in Xinjiang wrote with dark foresight, “Perhaps an awakening China, wondering where to settle its surplus millions of people, may have the good sense to call in the science of the West and to develop [Xinjiang].” But through the early 20th century, the Chinese government did not extend its influence to the distant region, and the Uygurs twice declared their own independent country. The second attempt at self-determination, in 1944, lasted five years, until the rise of Mao and the Chinese Communist Party, which sent in military forces and later established a nuclear testing ground, Lop Nur, in Xinjiang to eliminate any confusion.

Realizing that, if nothing else, its big, empty territory provided a buffer against foreign influence, Mao’s China instituted a program called the Xinjiang Production and Construction Corps—combining farm, military garrison, and prison—in which settlers from other Chinese provinces would work the soil and watch the borders. The first arrivals, in 1954, included more than 100,000 demobilized soldiers. Some were coerced, but the flow gathered momentum as the government extended a railroad west to Urumqi in 1962 and used promises of food and clothing to entice residents from overcrowded cities like Shanghai.

Meanwhile the Chinese were discovering that Xinjiang offered far more than just a border cushion: It held something vital to their very survival as a nation. Xinjiang contains about 40 percent of China’s coal reserves and more than a fifth of its natural gas. Most important, it has nearly a fifth of the nation’s proven oil reserves, although Beijing claims it holds as much as a third. Never mind the massive deposits of gold, salt, and other minerals. Xinjiang isn’t empty. It’s strategic. And with that realization, other things came sharply (Continued on page 46)





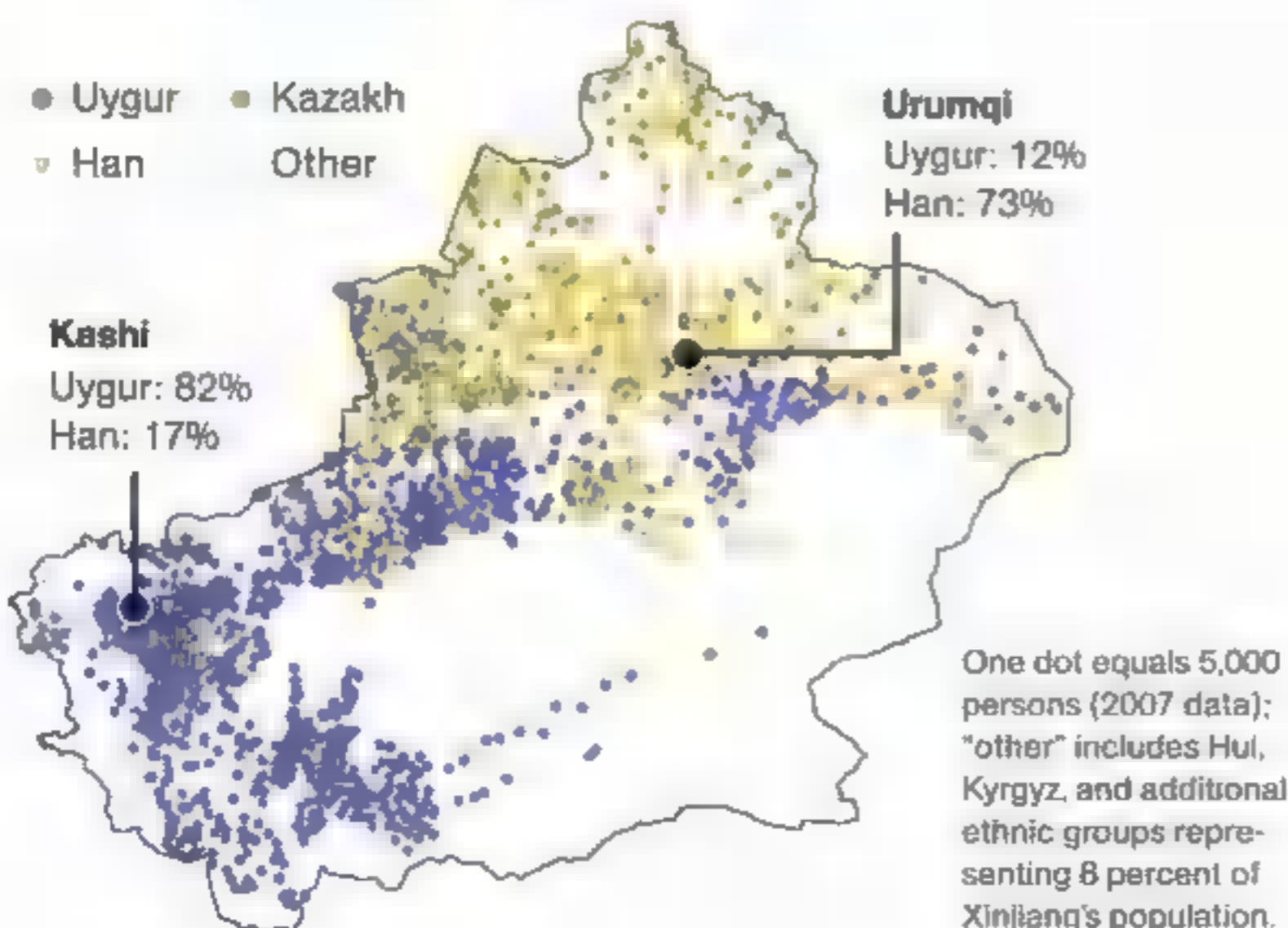
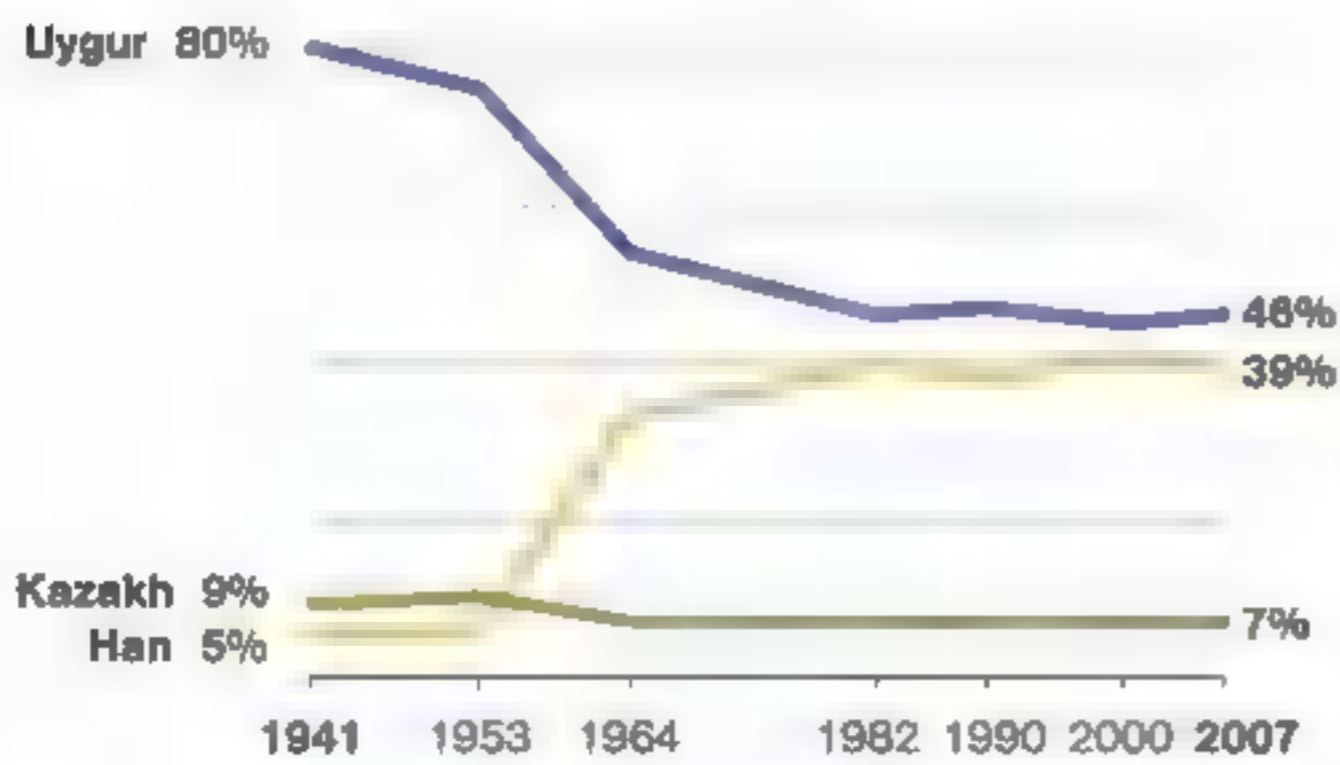
**DEMOLITION ERASES** another block in Kashgar's Old City, center of Uygur life in the historic oasis town. Claiming that the long-standing mud-brick structures are unsafe, officials clear space for high-rises.

# EXPLOITING A RICH FRONTIER

Where merchants once trekked through western China on the Silk Road, today pipelines, highways, and railroads serve as conduits of wealth. In recent years Xinjiang ("new frontier") has attracted a flood of Han Chinese, with many going to new town sites like Alar (right) on the desert rim. Uyghurs still dominate the rural south, but the north looks increasingly like the rest of booming China.



**NEWCOMERS** The population of Han Chinese in Xinjiang has swelled by 2.5 million since the 1990s, when Beijing's "Develop the West" initiative began a rush from the interior and the east coast. If the inflow continues, Han could soon outnumber Uyghurs in their traditional homeland.



Xinjiang is China's leading cotton producer, with 38 percent of the total. Most is grown on irrigated desert near Aksu and Kashgar.



## ENERGY IN XINJIANG

### COAL

40% of China's proven reserves

Coal-bearing area

### GAS

21% of China's proven reserves

Natural gas pipeline

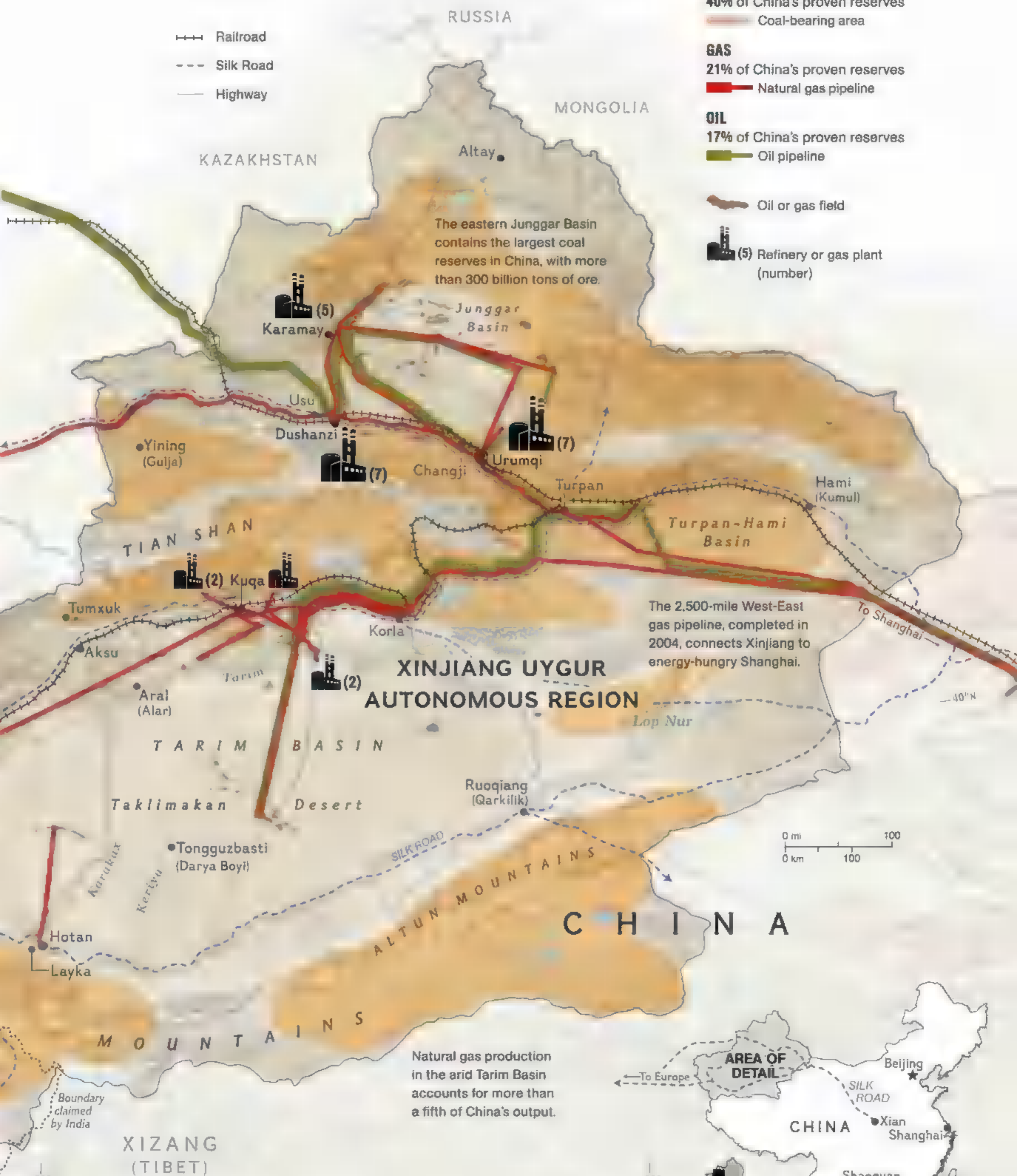
### OIL

17% of China's proven reserves

Oil pipeline

Oil or gas field

(5) Refinery or gas plant (number)



## XINJIANG UYGUR AUTONOMOUS REGION

The 2,500-mile West-East gas pipeline, completed in 2004, connects Xinjiang to energy-hungry Shanghai.

The eastern Junggar Basin contains the largest coal reserves in China, with more than 300 billion tons of ore.

Natural gas production in the arid Tarim Basin accounts for more than a fifth of China's output.



**DISTINCTLY UYGUR**, the Sunday bazaar in Layka teems with shoppers in colorful scarves and embroidered caps. Here livestock sales, the hawking of crafts, and matchmaking schemes unfold as in generations past.





into focus for China's leadership: Xinjiang is the largest, most far-flung region. It borders more countries than any other. And it's home to an ethnic group that has tried twice in living memory to make a break for freedom.

In 1947, during the second incarnation of Uygur independence, about 220,000 Han Chinese made up 5 percent of Xinjiang's population. Uygurs numbered about three million, or 75 percent, the remainder being a mix of Central Asian ethnicities. By 2007 the Uygur population had increased to 9.6 million. But the Han population had swelled to 8.2 million.

Some Uygurs found opportunity in the influx. In the 1980s in burgeoning Urumqi, a laundress named Rebiya Kadeer grew her business into a department store, then built that into an international trading empire. She became one of the wealthiest people in China and an inspiration for her compatriots—a Uygur woman who appeared in Asia's *Wall Street Journal* and met with such businessmen as Bill Gates and Warren Buffett. In many ways she seemed emblematic of Xinjiang: In the last two decades of the 20th century the region's GDP increased tenfold.

But many more Uygurs languished. The big

business in Xinjiang is oil, but all that oil is controlled from Beijing by state-owned energy companies. Many of the good jobs in Xinjiang are government jobs, and employees can advance more readily if they join the Communist Party, which requires renouncing their religion. And most Uygurs won't do that. The result is an ironic and combustible symmetry: As Han settlers pour in, Uygurs, unable to find work in their fantastically wealthy and spacious homeland, migrate east to work in privately owned factories in crowded coastal cities.

IN THE PAST FEW DECADES local resistance has flared up around Xinjiang, fluctuating in scale and violence. During the 1980s Uygur students protested treatment by police in a handful of incidents; in 1990 a disturbance south of Kashgar against birth limits ended in perhaps four dozen deaths. In 1997 hundreds of people in a city called Gulja marched to protest repression of Islamic practices and were arrested; the number of casualties is unknown. Other examples abound, including bus bombings and assassinations.

The Chinese government realized that it had



**DAYBREAK** in the village of Darya Boyi finds ■ daughter doing chores (left). Brightly draped wooden platforms serve as beds, and a future meal of mutton hangs from a hook. Uygur activists complain that government programs pressure young women in villages to move east to work in factories. Following tradition in the city, women in Kashgar (right) take home gifts of flatbread after a wedding.



**UYGUR HOMES ARE LIKE OYSTERS: ON THE OUTSIDE DRAB, BUT INSIDE, WALLS GLEAM, AND COLORED RUGS COMPLEMENT PAINTED CEILINGS.**

a problem in Xinjiang, much as it had a problem in neighboring Tibet. Along with regulating mashraps—those traditional gatherings—the state monitored services at mosques, afraid they might provide a platform for dissidents. In general, officials downplayed the unrest as the work of isolated “ruffians” in a Uygur population that was otherwise blissful. In early September 2001, Xinjiang Communist Party Secretary Wang Lequan announced in Urumqi that “society is stable, and people are living and working in peace and contentment.”

A few days later Beijing received a potent and unexpected propaganda tool: September 11.

As America and much of the West launched the “war on terror,” China recognized the momentum of global public opinion and chose a new tack. The shift happened so fast it came with an almost audible crack. On October 11 a spokesman for the Chinese Foreign Ministry described China as “a victim of international terrorism.” Then the government issued ■ report

on unrest in Xinjiang blaming none other than Osama bin Laden. “It’s an effective strategy,” says James Millward, a professor at Georgetown University and an expert on Xinjiang, “because in America we see Muslims somewhere who are unhappy and maybe even violent, and we assume it’s because of religious reasons.”

And just like that, the Uygurs—with the complexity of their culture, the richness of their past, the fullness of their grievance against the Chinese state—fell into a tidy classification. China asked the United States to include a group of militant separatist Uygurs on its list of terrorist organizations but was rebuffed—at least at first.

In December 2001, 22 Uygurs were captured in Pakistan and Afghanistan, where they may have received weapons training with the intent of battling the Chinese military back in Xinjiang. The men were rounded up by bounty hunters, handed over to U.S. forces, and sent to Guantánamo Bay. (Years later a U.S. court would order their release.) In August 2002 Deputy Secretary of State Richard Armitage traveled to Beijing to discuss, among other issues, America’s upcoming mission in Iraq. While there, he announced a reversal in the U.S. stance: A militant Uygur group



**NEAR HOTAN:** gamblers crowd around after a *gamb*  
a sharp contrast in the ball dances and wrestling  
matches *Uygurs* perform for tourists. In (view of) *Uygurs*  
especially men and women and to socialize separately



called the Eastern Turkistan Islamic Movement would now be listed as a terrorist organization.

THE HEART OF UYGUR tradition is the ancient capital of Kashgar. Today its Old City looks much as it must have when Marco Polo spied it after descending through the mountain pass—a warren of passageways and ancient mud-brick homes that resemble a jumble of oversize children's blocks. Early this year the Chinese government undertook a bold step: They began systematically bulldozing the Old City block by block and moving the inhabitants into a new compound on the edge of town.

Uygurs don't discuss the subject in public for fear of imprisonment, but one man who lives in the Old City, Ahun, agreed to talk with me in his home. A rendezvous would not be easy, because for days the Chinese security services had been following me. I was to wait in the main square during the busy midday until I saw him pass under Mao's statue, then follow at a distance without acknowledgment.

As we walked through city streets, he stopped casually to take a drink of water at a cart and later to tie his shoe. Finally we entered the Old City. The Chinese government's ostensible reason for demolishing the neighborhood is that it's too old to withstand an earthquake. But there may be another motive. As Ahun and I wove our way deeper into the warren, I watched his shoulders relax and his gait loosen. He was hard to trace in here. The Old City is a refuge.

The homes are adjacent and interconnected, and each is two stories high and arranged around a central courtyard. I followed Ahun up a flight of stairs, and when he flung open the door, it struck me that these homes are like oysters: On the outside they're drab and crude, but on the inside whitewashed plaster walls gleam, and many-colored rugs complement painted ceilings. "I pray. When I worship, I ask Allah, 'Rescue me my house,'" Ahun said. From his house he has a clear view of a government wrecking crew at work on a nearby home. According to the demolition schedule, they'll arrive at Ahun's home in three years.

**IDLING** at a night market in Kashgar, a motorcycle taxi driver waits for his next fare. Limited job opportunities tend to stall many Uygurs as the gap widens between haves and have-nots. According to a U.S. government report, in a recent recruiting effort the Xinjiang Production and Construction Corps reserved some 800 of its 840 civil service job openings for Han workers.



He was born in the house, he said. So was his father. So was his grandfather, after his great-grandfather built it on family land. "I have two sons," he said. That's five generations who have lived in the same house.

If Hotan represents Xinjiang's past—with a Uygur majority that gathers to sharpen knives, trim beards, sing songs—then Kashgar is its present. Uygurs still make up most of the city's population, but their culture here is embattled. The government is working fast to tear it down.

Given enough time, Ahun said, China's economic development will bring political change, and hope for his people. "China will be obliged to receive a democratic system," he said. But right now, for a man who prays each day for the survival of his family home, no act is too desperate. "You do not understand our rage,"



he said. “In the Middle East there are human bombs, who connect their bodies with bombs. But with our rage, we don’t need bombs connected. We ourselves explode.”

IN JUNE OF THIS YEAR, ■ disgruntled worker at a toy factory in Shaoguan, near Hong Kong, reportedly claimed that Uygurs had raped two women. A melee followed. The violence lasted several hours and left scores injured. Angry Han workers in the factory’s dormitory beat to death two Uygur co-workers.

This spark lit a fire 2,000 miles away, in Xinjiang. On July 5 thousands of Uygurs—the numbers reported varied widely—took to Urumqi’s streets to protest the treatment of the Uygur workers. The authorities were caught off guard.

I spoke to a young woman named Arzigul,

who had attended the protest. She said it started off peacefully as young people circulated around the capital’s public square. “They were screaming the name ‘Uygur! Uygur! Uygur!’” she said. When security forces arrived, something happened—exactly what is unclear. Each side says the other struck first, but at some point the authorities tried to quell the crowd, which apparently devolved into a mob attacking Han on the street. Two days later a group of Han—apparently numbering in the thousands—took to the street with meat cleavers and clubs and knives. They in turn attacked Uygurs.

Chinese officials say they’re protecting their citizens from terrorists. In July, Vice Foreign Minister He Yafei called the riots “a grave and violent criminal incident plotted and organized by the outside forces of terrorism, separatism,



**UNBOWED BY A SANDSTORM,** pilgrims pray at the graves of Islamic saints during the Imam Asim festival near Hotan. Chinese officials restrict activities at mosques but so far have tolerated rural religious gatherings.



and extremism.” James Millward, the Xinjiang expert, says many Han—even officials—sincerely believe Xinjiang faces a threat from terrorists and interlopers. “It’s what they are constantly told.” Eventually military forces and police clamped down on Urumqi, and there seemed no possibility of further unrest. That’s when the three men emerged from the mosque in the Uygur quarter, scattering people in every direction.

I WATCHED THEM stride up the street and back, then run at the Chinese forces. First came the single shot, which missed. The Uygurs continued their charge, and I realized that the running men with their rusted swords did not expect to prevail. They expected to die.

A moment later another officer released a burst of automatic fire. The lead Uygur—the man in the flowing blue shirt—fell with the sudden slackness of a thrown rag doll. His body hit the pavement, but the momentum of his sprint sent him tumbling, and his feet flew up and over his head.

For a few seconds the incident played out in tableau on the opposite sidewalk. The remaining two Uygurs ran into the street, and the scene became three-dimensional, with bullets flying in my direction. I ran into a nearby building and found myself in the lobby of an enormous department store. People pressed themselves into corners and behind clothing displays; women wailed, and two men improvised a door lock by shoving a metal bar through the door’s handles. Beyond the building’s glass doors, all three of the Uygur men now lay in the street, one injured and two dead. Soldiers, police, and plainclothes security officers were firing upward, into the windows of surrounding buildings.

The department store held special significance for the Uygurs. It belonged to their heroine Rebiya Kadeer, the laundress turned mogul who had become beloved after she began to speak out against China’s treatment of the Uygurs. In 1999, as an American delegation arrived in China to meet Kadeer, security officers arrested her. She spent the next six years in prison, then joined her exiled husband in the U.S. Her imprisonment only raised her

**A UYGUR DISCO** in Hotan attracts young couples to a nightlife of their own. The scene belies the official Chinese portrait of Uygurs as “colorful, quaint folks,” says China scholar James Millward. “In the cities they are modern and worldly.” Many Uygurs also fight the separatist label. But unless more of Xinjiang’s wealth is shared and their culture is respected, more Uygurs will demand change.



status among her people, who regard her as the “mother of all Uygurs.”

She’s a grandmother, just over five feet tall, and she terrifies the Chinese authorities. Mentioning her name in Xinjiang brings swift and severe punishment. When I went with Ahun to his home in Kashgar’s Old City, he spoke freely of rebellion against China’s government, but when I mentioned Rebiya Kadeer, he froze. “If China finds this,” he said, pointing to my voice recorder and then reaching for my throat in mock vengeance, “on Judgment Day I will catch your neck.”

After the July riots, trucks with loudspeakers circled the public squares of Urumqi, proclaiming that the unrest had been organized by Kadeer from her office in Washington, D.C. Chinese officials accused her in news reports





around the globe and were said to be planning to tear down her trade centers. “The Chinese authorities are fearful of me because of what they have been doing to the Uygur people,” she told me recently. In her office an enormous East Turkistan flag—symbol of a free Uygur nation—hangs on one wall, and photos of her 11 children, two of whom are in prison, hang on another.

The Western world knows of the struggle for freedom by Tibetans largely because the Dalai Lama presents a warm and charismatic embodiment of his people. The Uygurs have remained obscure, in part, because they have no such figure. But the Chinese government’s recent efforts to demonize Rebiya Kadeer have lifted her into a representative role. “I keep advocating for my people, for the self-determination of Uygurs,”

she told me. Whether that means autonomy within China or a push for full independence depends on the government’s reaction, she said. “At the moment I’m trying to invite the Chinese authorities to come to the dialogue peacefully.”

Even as Kadeer spoke, another round of strife loomed in Xinjiang—rumors, allegations, protests—and she acknowledges that a peaceful resolution may be impossible. After seeing the region’s past and present through Hotan and Kashgar, we may be glimpsing its future in Urumqi: a sprawling city that serves Han migrants drawn by Xinjiang’s natural resources, where a Uygur minority stays confined to its quarter.

And on an otherwise silent Monday afternoon, men detonate on the street from the sheer force of their rage. □



# RESURRECTION ISLAND

*Once a scene of slaughter, icy South Georgia is awash with life again.*



◆ penguin-speckled iceberg floats  
◆ in the ocean off South Georgia.  
This remote British outpost in the far  
South Atlantic is a haven for millions  
of seabirds and seals.





Sinuous for its size—up to 12 feet and more than a thousand pounds—the leopard seal is a formidable predator, its mouth often stained with the blood of penguins and other seals.



Giants patrol the beach at St. Andrew's Bay, thronged by king penguins and elephant seals. During the breeding season South Georgia makes the densest mass of marine mammals on Earth.



South Georgia rises sheer and stark from the sea, a hundred-mile arc of dark Antarctic peaks, ice fields, and hanging glaciers. From the deck of a ship, the island makes a startling apparition, like the Himalaya just emerged from the Flood. For a polar outpost so solid and austere, covered half by permanent snow and ice and half by bare rock and tundralike vegetation, South

Georgia is strangely chimerical. Its meanings are contrary and elusive. Its moods are mercurial, brightening one moment, darkening and spitting sleet the next, then brightening again. The island seems marked in some unusual way, simultaneously favored and cursed. Few spots on Earth are so full of ambiguity and paradox.

The first paradox for the visitor has to do with one's latitude of departure. To travelers arriving from the north, the island seems forbiddingly antipodal and cold. To travelers arriving from the south, voyaging up from the Antarctic Peninsula, the island seems almost tropically lush. (In Antarctica there are two native species of vascular plants; on South Georgia there are 26.) To the explorer Ernest Shackleton—whose ship *Endurance* was crushed nearly a century ago by Antarctic pack ice, who rallied his crew through 16 months of entrapment in the floes, and who escaped finally with five of his men in a small lifeboat, crossing 800 miles of mountainous seas to the whaling stations of South Georgia—that snowy island looked like paradise.

Last February photographer Paul Nicklen and

I retraced Shackleton's route. We left the Antarctic Peninsula and sailed, as Shackleton had, just offshore to the South Shetland Islands, from which the explorer had launched his desperate run for South Georgia. His lifeboat, *James Caird*, was 20 feet long. The cruise ship on which Nicklen and I hitched a ride, *National Geographic Explorer*, was 367 feet and 6,000 tons. Where Shackleton's little vessel was pounded by a hurricane and a succession of gales, our big ship enjoyed fair weather. I was beginning to feel cheated of the true Antarctic experience when we raised South Georgia, which greeted us with hurricane-force winds of 110 miles an hour.

The second paradox of South Georgia is the crazy changeability of its weather. The Southern Ocean, as some call the seas that encircle Antarctica, has, on average, the strongest winds on Earth. There is little to weaken them, for these far southern latitudes circumscribe the entire globe almost without interruption by land. Low-pressure areas are free to chase one another eastward around the bottom of the planet like a howling dog in pursuit of its tail.

South Georgia sometimes seems like a time-lapse film of weather—one of those frantic abridgments in which clouds boil across the sky while a stroboscopic flickering of light and

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*Kenneth Brower writes regularly about wildlife and wild places. Photographer Paul Nicklen's latest collection of Arctic images is titled Polar Obsession.*





The wreck of the catcher boat *Petrel* lies stranded at the abandoned whaling station of Grytviken. *Petrel* and her sisters did their work too well, depleting some whale species and nearly exterminating the blue. By the 1960s there was little left to hunt.

shadow passes over the land. You sail into a bay in bright sunshine and air scrubbed clean by the ceaseless circumpolar wind. You really can see forever. The steep headlands are an intense, improbable green. Depth of field is infinite, from the kelp beds in the foreground to the snows of the peaks beyond. A glacier, cradled in its high cirque, sends a skein of streams down the rock wall, icy rivulets glittering so bright they hurt the eyes. Then, moments later, like Dorothy whirled back to Kansas, you look out on that same emerald Oz rendered suddenly in gray halftones. A new front has blown in. The sun

is just a dimly glowing patch of cloud across which flurries of snowflakes swirl and eddy, dark patterns against the glow. South Georgia suffers from a meteorological version of bipolar disorder.

The third paradox is historical. In bay after bay the backdrop is pristine—the trackless peaks, snows, and glaciers that form the spine of the island—while the foreground is tarnished by the wreckage of a whaling station, one ruin after another, rusting away above a pebbly beach reclaimed by penguins and seals. South Georgia is a virgin wilderness that lost its virginity

yet is becoming virginal again. Here paradox verges on miracle: The island, epicenter of one of the worst marine mammal massacres in history, now teems with multitudes on the scale the planet knew before the invention of the spear, the bow, and the gun.

Captain James Cook, after exploring South Georgia in 1775, dutifully reported an “island of ice” that he briefly mistook for the southern continent he had been sent to find. Then, fatefully, he went on to mention the extraordinary abundance of seals. Scarcely a decade later the first sealing vessels arrived. In the sealing season of 1800-1801, a single ship, *Aspasia*, out of New York—just one of 18 American and British sealers then working the island—brought back 57,000 pelts. The Antarctic fur seal, *Arctocephalus gazella*, would be hunted to the verge of extinction. The southern elephant seal too would be brought low, killed in great numbers for the oil rendered from its blubber.

Next came whalers. First they chased down slower whales such as rights, humpbacks, and sperm whales. Then, early in the 20th century, with the invention of fast, steam-powered catcher boats and explosive harpoons, they built whaling stations on South Georgia and turned their attention to the big, fast baleen species, the fin and blue whales. The largest whale ever recorded, a female blue more than 110 feet long, was hauled ashore at South Georgia’s Grytviken whaling station in 1912.

The 1920s saw the introduction of factory whaling ships that could catch and process whales on the high seas without needing shore stations. Grytviken and South Georgia’s other whaling bases slowly declined. For me, these ghost towns of rusty flensing platforms, boilers, chimneys, and whale-oil storage tanks were poignant. The year before, on assignment for this magazine, I had spent a month in the tropical Pacific with the largest remnant population of blue whales (see “Still Blue,” March 2009). I had come to understand the blue whale slaughter intellectually—that in just four decades we nearly extinguished the largest creature ever to live—and now I grasped it viscerally. Here was

the hard evidence in oxidizing steel that rang dully under my knuckles. The blue whale had disappeared into these giant tanks, arranged in long rows as at any refinery.

But just as sun follows sleet in South Georgia, so it is with the oil-tank blues. They are soon chased away by the reality of the present. It is the whaling stations that are now extinct. It is

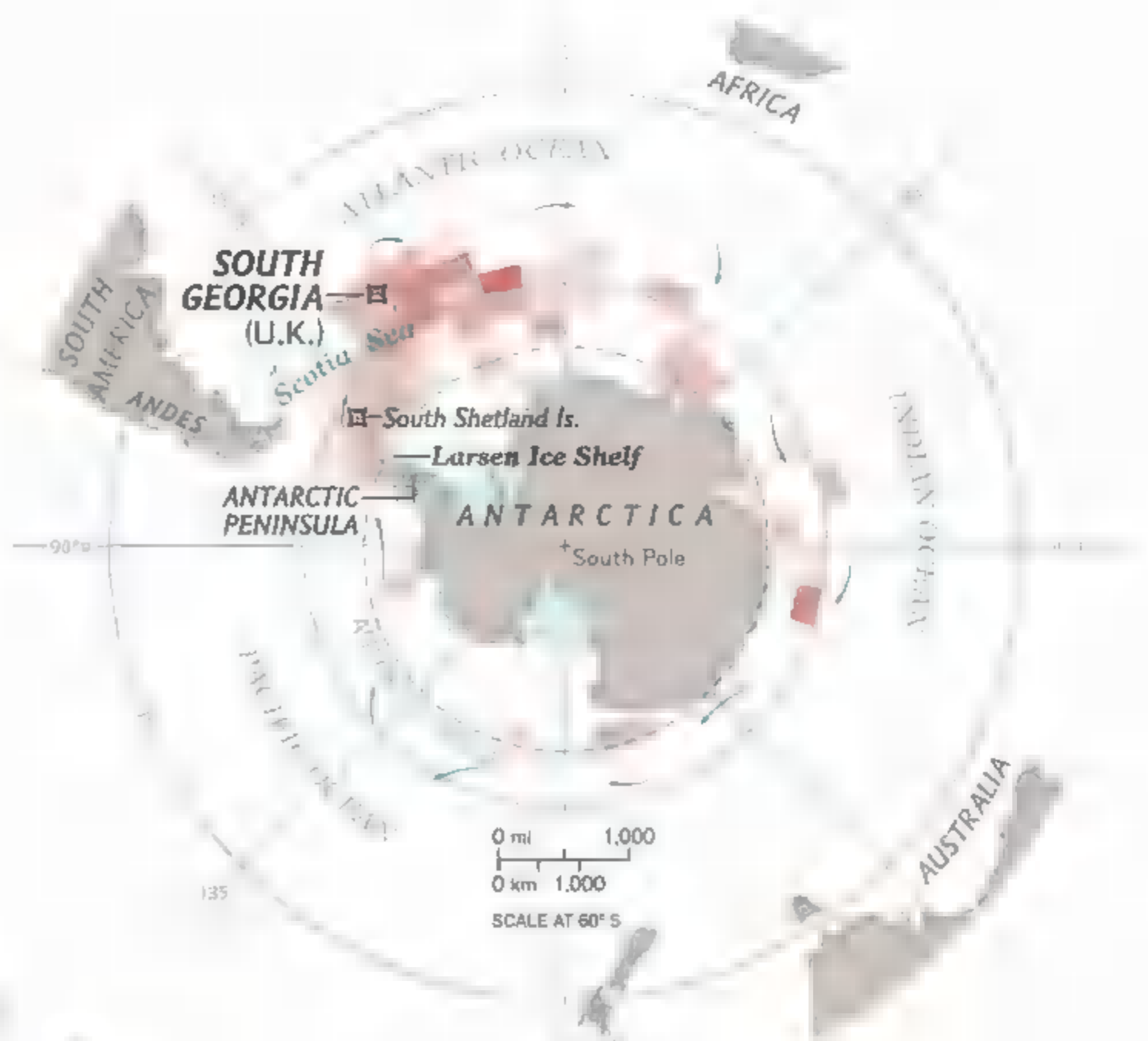


the sealers who are long gone. Most of the victim species have come back strong—the blue whale being a notable exception—and today these rusting death camps are mobbed by life.

**A WHITE WALL** three feet tall—the massed shirt-fronts of a phalanx of king penguins—greet a skiff or Zodiac approaching the beach at St. Andrews Bay. The white wall here was once 65 feet tall and made of ice—the terminus of the Cook Glacier. But for the past 30 years all three glaciers of St. Andrews have been in galloping retreat, and penguins have stepped in to fill the void. Walk up to the beach crest and the view opens up: to the south, penguins forever, a rookery of 150,000 pairs, the largest king penguin colony on South Georgia. The birds crowd shoulder to shoulder, except where glacial rivers clear channels through the rookery. Along the beach where the Cook Glacier once calved great pinnacles of ice into the sea, the rookery now calves flotillas of king penguins. They raft socially for a while, then melt away to go fishing.

The king is the second largest penguin, about

**A CRESCENT OF MOUNTAINS** that spire to nearly 10,000 feet, South Georgia is a lost piece of the Andes. Pushed far east by tectonic forces, the island rests in a vital spot for marine life—north of the zone where sea ice forms, yet still bathed in a food-rich current streaming up from Antarctica.



MARTIN GAMACHE, NG STAFF; CAITLIN SARGENT  
 SOURCE: ANTARCTIC KRILL CONSERVATION PROJECT;  
 BRITISH ANTARCTIC SURVEY

a foot shorter than the emperor. Like other penguins, it undergoes an annual molt, replacing all its feathers in a few weeks. At the time of my visit, 10 to 15 percent of the adults were in the grip of this transformation. Amid the multitudes in sleek evening garb, the molting birds had the look of disheveled bounders or tipplers in moth-eaten raccoon coats.

Mixed with the penguin multitudes were many hundreds of Antarctic fur seals, mostly pups, sleeping or jousting or playing tag in small gangs. Young seals long ago reached a truce with penguins but not with humans, and the pups like to make bluff charges at people. The attacks are entirely bogus. Clap your hands, shout "Stop!" and the pup instantly loses courage and veers off sheepishly. Elephant seal cows—as many as 6,000 in October, at the height of their calving season—add to the crush at St. Andrews Bay.

Both fur and elephant seals have made spectacular rebounds. By the early 1900s, after a century of hunting, only a relict population of Antarctic fur seals survived on South Georgia. Today they number in the low millions, the vast majority of which breed on South Georgia. Likewise, hundreds of thousands of southern elephant seals come to the island each summer to breed and to rear their young.

South Georgia's king penguin populations too are soaring. In 1925 only 1,100 kings were counted at St. Andrews Bay; since then there has been a 300-fold increase in the rookery. A gathering of 300,000 penguins would usually raise a deafening roar of debate and protest and recrimination, but at the time of my visit the nesting birds were relatively laconic. There was no great din at St. Andrews Bay; the loudest noise here was visual, the sheer spectacle of numbers.

In places, the rookery's soil seemed composed mostly of the narrow white barbs of breast feathers, spiky with barbules, and loose feathers lay in drifts on the ground. Gusting winds sent ground storms of feathers scurrying seaward. Seen from a distance, the effect was like heat shimmer over the whole rookery. Somehow these feather blizzards, more even than the

legions of birds that generate them, testify to the exuberance of life on South Georgia. Watching, I was moved almost to tears. I grew up in a family where environmentalism was religion; here in this rookery, for someone of my faith, was life as it is supposed to be, in all its amplitude.

This sort of epiphany waits in almost every bay and inlet of South Georgia. Sometimes the animal multitudes are horizontal, as on Salisbury Plain, a glacial outwash delta densely colonized by king penguins, fur and elephant seals, and kelp gulls. Other times they are vertical, as at Elsehul, where the shores and lower slopes are thick with penguins, fur seals, shags, and sheathbills, while the steep, tussocky headlands are dense rookeries of grey-headed, black-browed, wandering, and light-mantled sooty albatrosses as well as skuas and Antarctic terns.

**THIS PROFUSION OF LIFE** has a secret: South Georgia is a relatively temperate island in the path of a seasonal swarm of krill borne up by currents from the Antarctic Peninsula—a living river of small, red, shrimplike crustaceans. If South Georgia has a special dispensation, it is this river of krill. It fed the largest herds of fur seals and great whales on Earth in the ages before the sealers and whalers came. Today it is fueling the astonishing resurrection of the Antarctic fur seal, as well as the slow but steady recovery of several whale species.

Periodically, once or twice a decade, the river of krill seems to go astray. The year 2004 was a poor krill year at South Georgia, and 2009 has been a very bad one. A trend often masquerades as a cycle at the start, and evidence suggests that these scarce krill years may foreshadow a new South Georgia. A 2004 paper by Angus Atkinson of the British Antarctic Survey presented evidence of a 30-year decline in krill over a wide sector that holds more than half the krill stocks in the Southern Ocean.

Krill, especially the larvae, are dependent in winter on sea ice, and for the past few decades this layer of frozen seawater has been shrinking in some parts of the Antarctic (although overall it has increased slightly). Earlier this year a



A light-mantled sooty albatross looks down on Gold Harbour. Individuals of the species can live past 40, so this nesting bird may have witnessed ■ change in view. In 1985 a glacier buried this shore; since then the ice has retreated a half mile inland.

team of oceanographers reported that the seas to the west of the Antarctic Peninsula have been warming many times faster than the world average over the past 50 years. The warming is strongest near the surface and in winter—not good news for winter sea ice.

Neither is the news good for Antarctica's ice shelves—glaciers that extend into the ocean. Much of the vast Larsen Ice Shelf collapsed in 2002, and the smaller Wordie Ice Shelf vanished last April. If the magnifying glass of global warming has a focal point, it would seem to be the seas of the western Antarctic Peninsula,

headwaters for South Georgia's river of krill.

On the day I left the island, the ship overtook an iceberg at sunset. It was the most beautiful thing I had ever seen. The glistening white wall towered above us, sheer as El Capitan and lovely in the last light of day. Icebergs have long been icons of the great white continent—Antarctica in microcosm. At a time when sprawling shelves of ice are disintegrating, this berg seemed to signify more. It was ■ last paradox. In this new era of climate change, icebergs are doubly symbolic, both of the pristine beauty of the Antarctic region and of the trouble that lies ahead. □



Soaring on seven-foot wings, a pair of light-mantled sooty albatrosses cruise the nesting cliffs of Gold Harbour. Nearly a third of all the birds of this species nest on South Georgia.

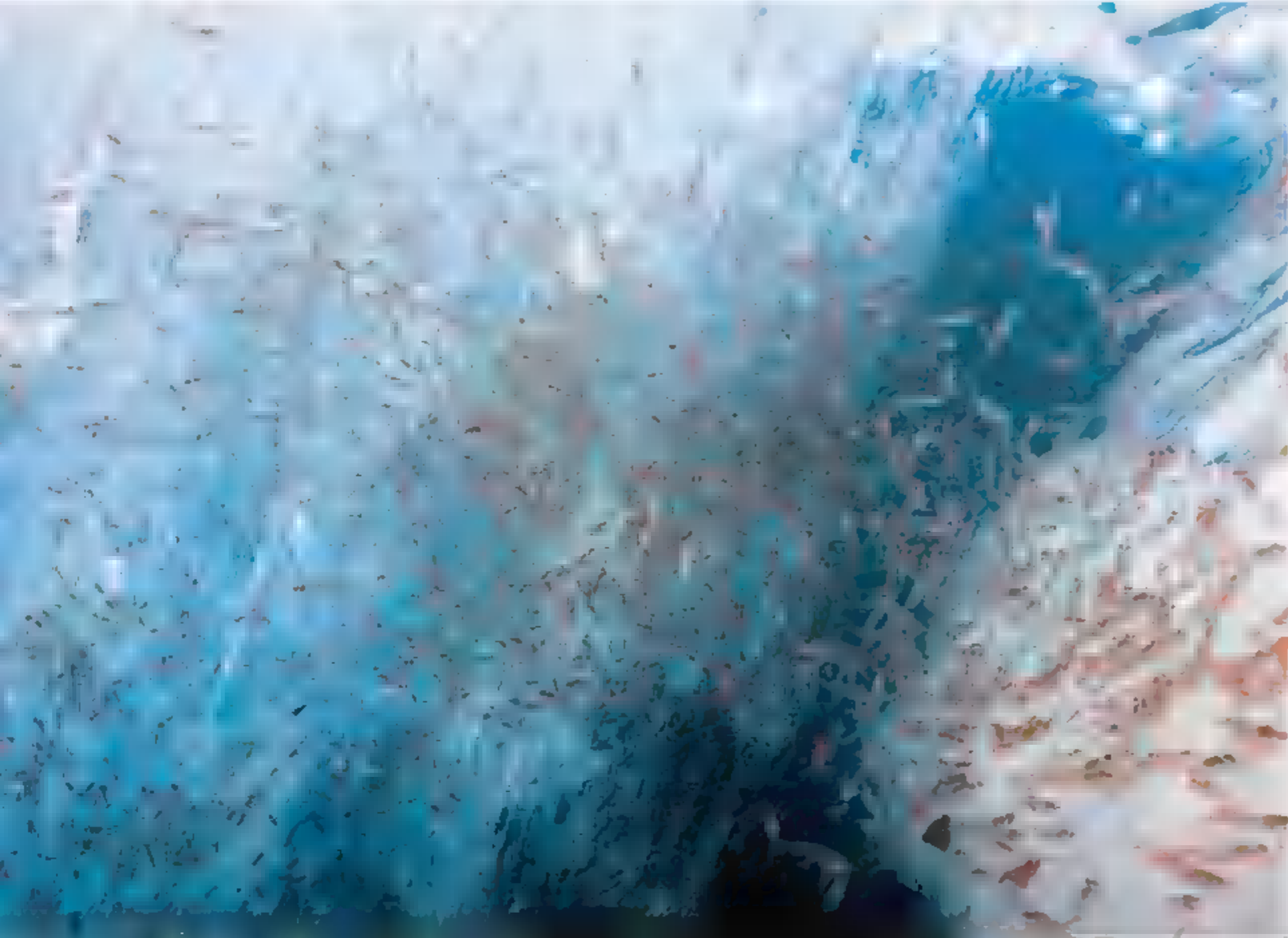
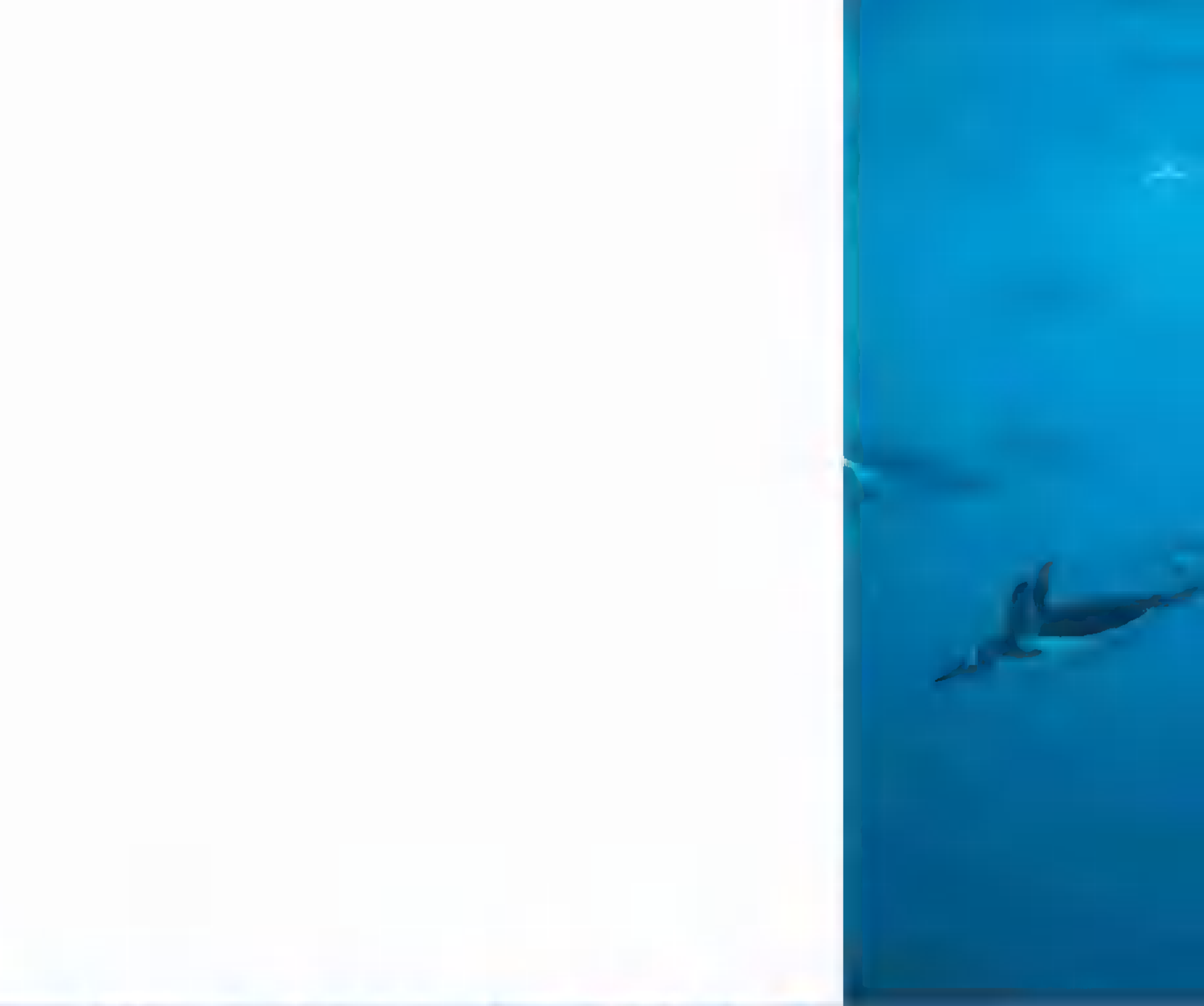




A bull elephant seal emerges from the surf at Fortuna Bay. During breeding season South Georgia's beaches become battlegrounds as big bulls engage in bloody duels for dominance.









A squadron of gentoo penguins (above) wings through the waters of Drygalski Fjord. Unlike true Antarctic penguins, the gentoo prefers more temperate climes. As oceans warm, this species is prospering, expanding its range southward. But there's a catch: Swarms of krill (left), the gentoo's primary food and a cornerstone of the entire Antarctic food chain, feed on phytoplankton that grows on the underside of sea ice. In recent years ice cover has been shrinking in waters west of the Antarctic Peninsula—source of South Georgia's krill.



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Lolling in a glacier-fed river (above) or keeping cool under a flipperful of sand (right), southern elephant seals can be mellow, like these two bulls. But photographer Paul Nicklen was attacked while snorkeling off a breeding beach. “One tried to crush me,” he says of a four-ton male. Using the housing of his underwater camera as a shield, he managed to escape with only sprained wrists. Two centuries ago, such encounters were almost always fatal—for the seal—but no longer. Once a killing ground, South Georgia is now a sanctuary.







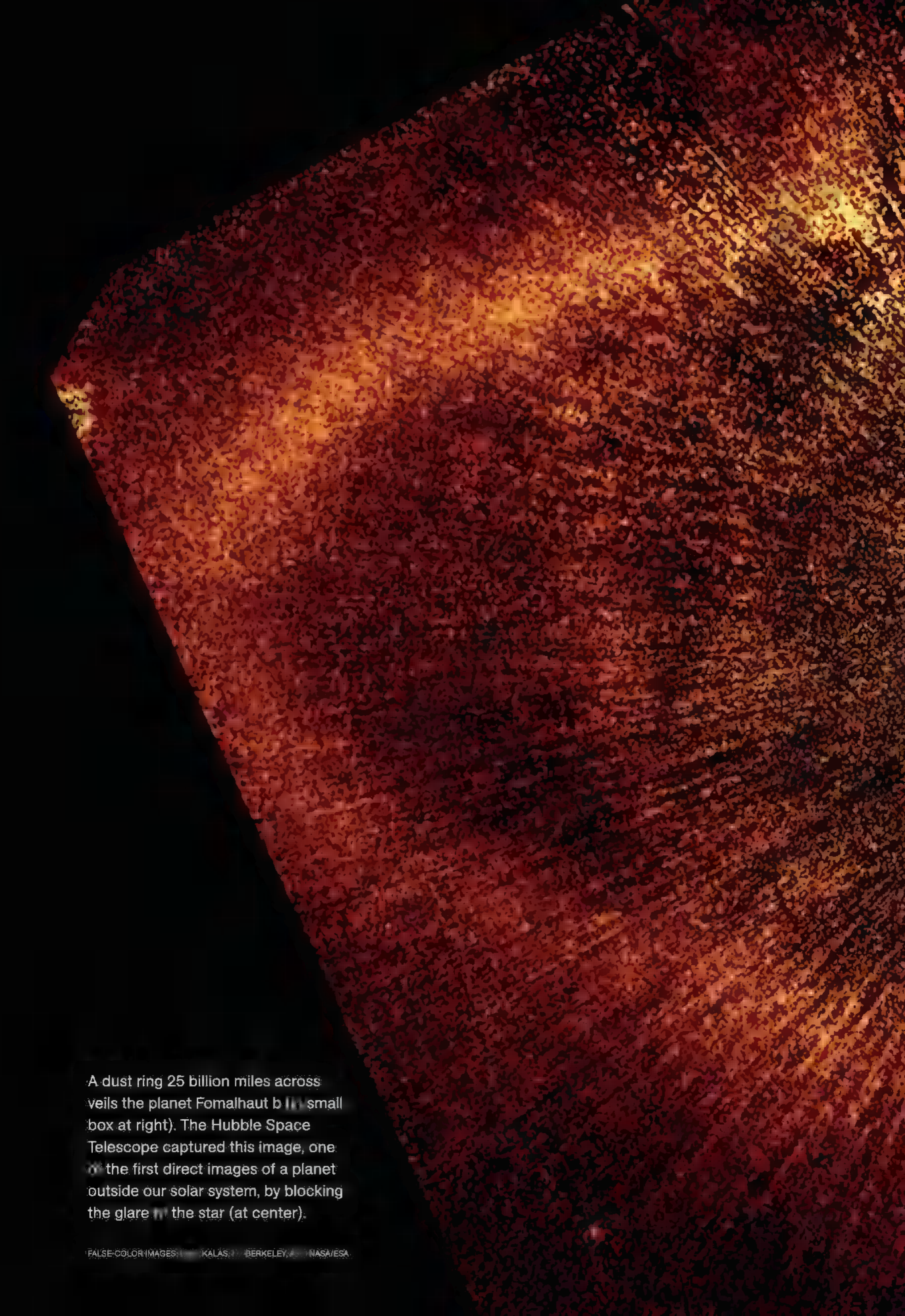


THROUGHOUT HISTORY, ONLY  
ONE EARTH HAS BEEN KNOWN  
TO EXIST IN THE UNIVERSE.  
SOON THERE MAY BE ANOTHER.  
AND ANOTHER. AND ANOTHER.

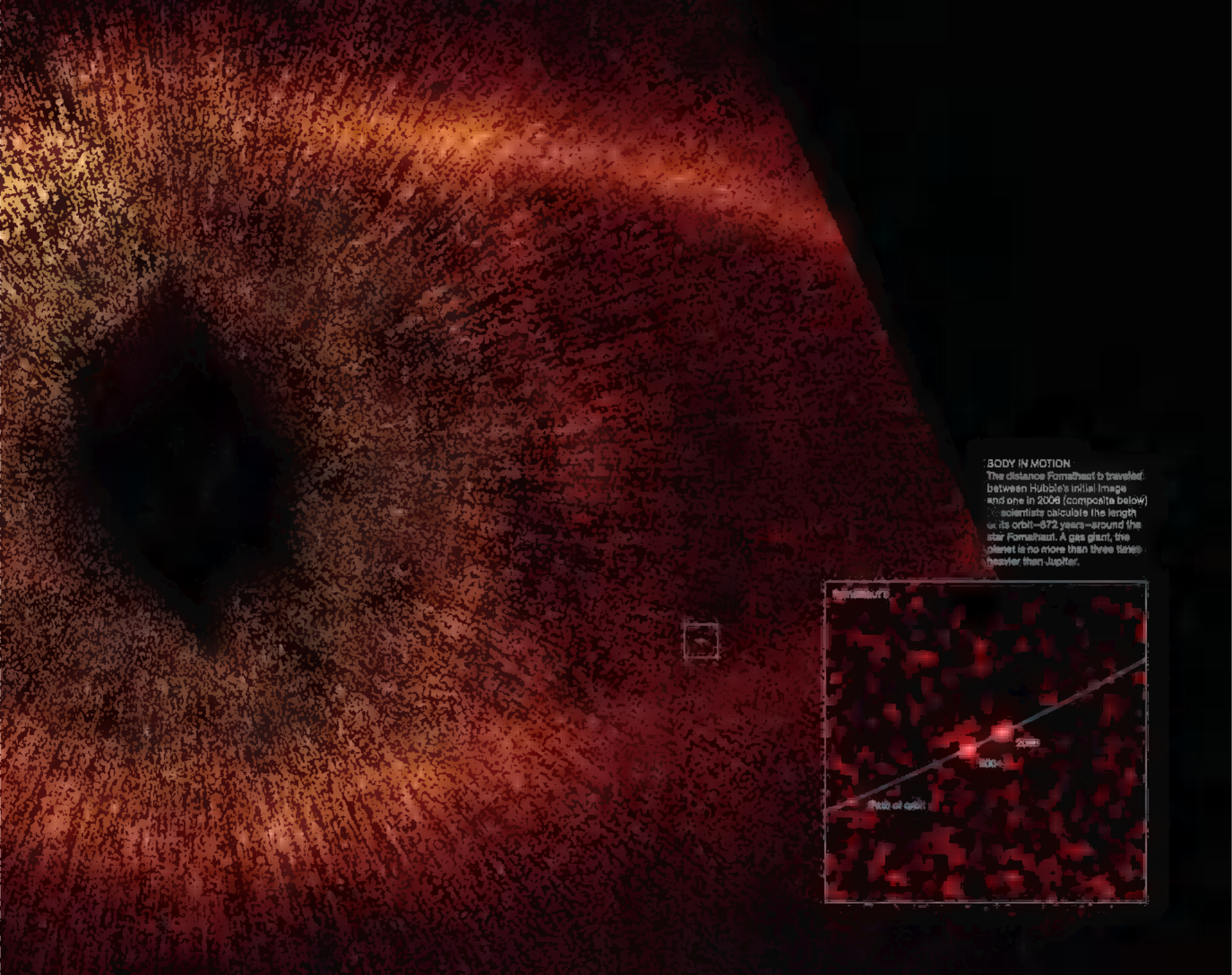
# *Worlds apart*

Like home? The four planets in the Gliese system, orbiting a star dimmer than our sun some 20 light-years away, include the newly found Gliese 581 e (foreground)—a rocky place just twice Earth's mass—and 581 f, which could harbor liquid water.

ART BY DANA BERRY  
SOURCES: MICHEL MAYOR, GENEVA UNIVERSITY; GEOFF MARCY, UC BERKELEY

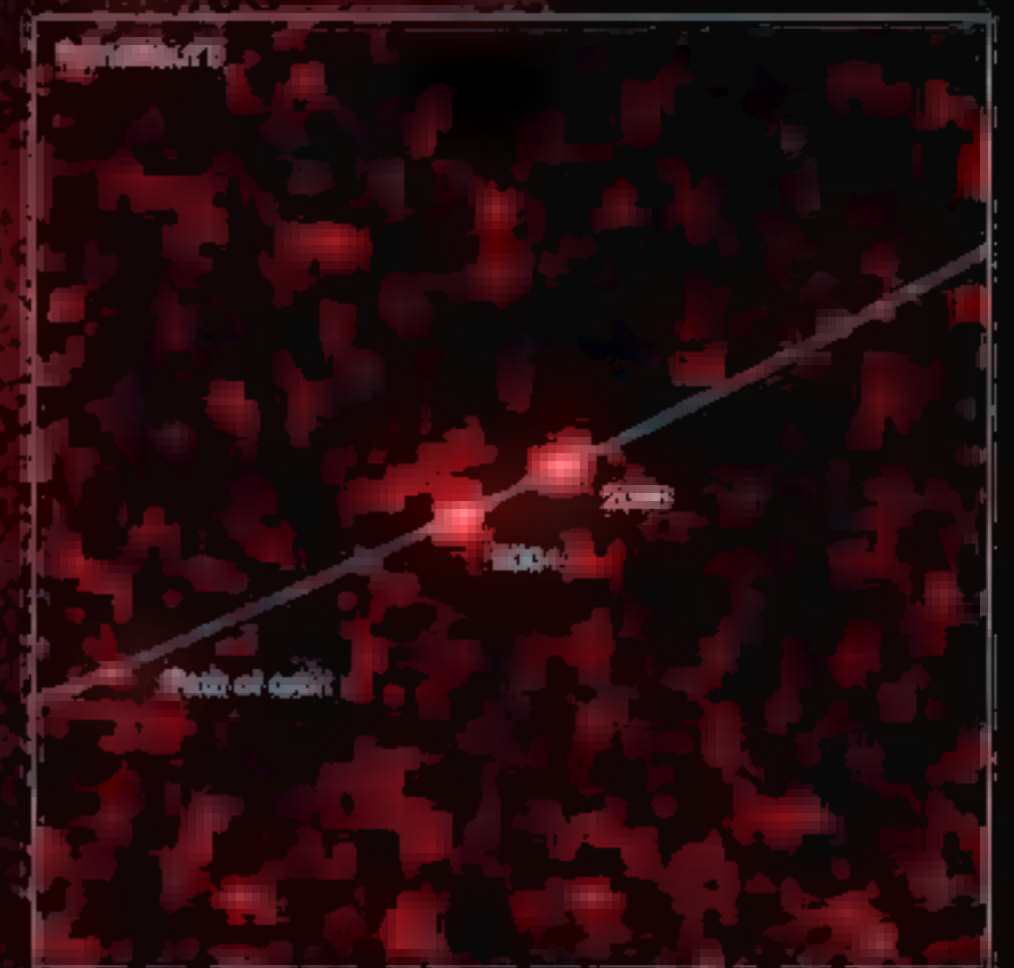


A dust ring 25 billion miles across veils the planet Fomalhaut b (small box at right). The Hubble Space Telescope captured this image, one of the first direct images of a planet outside our solar system, by blocking the glare of the star (at center).



#### BODY IN MOTION

The distance Fomalhaut b traveled between Hubble's initial image and one in 2008 (composite below) is 2.5 AU. Scientists calculate the length of its orbit—672 years—around the star Fomalhaut. A gas giant, the planet is no more than three times heavier than Jupiter.



# Searching space

"There can be nothing to hinder an infinity of worlds," wrote Greek philosopher Epicurus some 23 centuries ago. Now, with billions of others in space, stars and planets, we are beginning to believe. More than 370 distant solar systems have already been discovered, and our view of our Milky Way galaxy has been revolutionized. In fact, more than 100 billion stars and planets are likely to be scattered throughout the galaxy. As astronomers search for habitable planets, light with more powerful telescopes, we expect to discover other Earth-like planets, some perhaps, with all the makings of life.

## THE MILKY WAY

The arms of our galaxy spiral out from a central bar of stars 27,000 light-years long. Our solar system lies in a partial arm, the Orion Spur. In this view, based on infrared images from NASA's Spitzer Space Telescope, regions where new stars are forming appear in red.

## DISK OF THE MILKY WAY

Most of the stars in the Milky Way are located in the disk, which is about 1,000 light-years thick. The disk is divided into spiral arms, and our solar system is located in one of them. The disk is also the site of many star-forming regions, where new stars are born.

### STAR SYSTEMS

From our sun, 316 stars are known to have one or more planets. This chart shows 21% of those stars for which precise positions are known. Their distances are difficult to imagine: For all but the closest, it has taken centuries for their light to reach us. Planets form out of the disk of gas and debris that surrounds a newborn star. Among the various types of stars (below), classes O and B are still too young and too hot to be good candidates for Earthlike planets.

STELLAR CLASS	STARS WITH PLANETS*	TEMPERATURE (KELVINS)	MASS
O	0	30,000-50,000K	15 (More than 10 times mass of the Sun)
B	0	10,000-30,000K	2.1-16
V	83	2,700-7,800K	14-2.1
F	38	6,000-7,800K	1.04-1.2
G (Sun)	109	5,000-6,000K	0.8-1.04
K	71	3,000-5,000K	0.48-0.8
M	15	2,000-3,500K	Less than 0.45

\* Excludes data for which exact planet characteristics are not known.

Star above plane of our solar system

Star below plane of our solar system

**A 31 PEGASUS**  
FIRST SUNLIKE STAR CONFIRMED TO HAVE AN EXOPLANET

**B FONALHAUT**

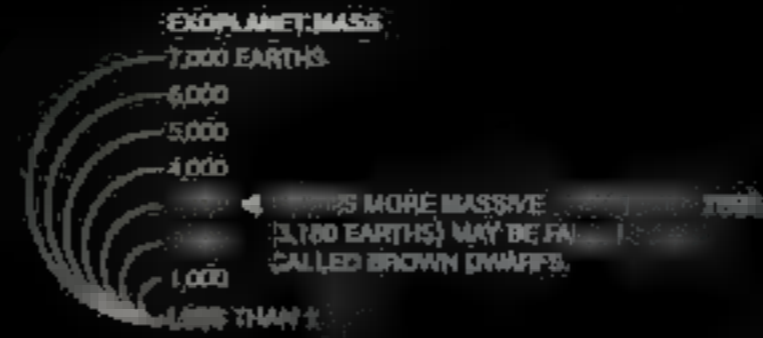
**C HD 40304**  
STAR OF THE MOST MASSIVE EXOPLANET (7.5X AS HEAVY AS EARTH)

**STARS WITH POSSIBLE TERRESTRIAL PLANETS**

- 1 GLEISE 807
- 2 HD 10149
- 3 GLEISE 581
- 4 HD 75284
- 5 HD 40307
- 6 HD 30438

# The known planets

By 2009, the rapidly growing number of exoplanets (573, plotted by mass and distance) had already discovered planets like Jupiter, which is easiest to find. Advances in detection in the past few years have identified 13 small, rocky planets close to Earth's orbiting star (red).



## EXOPLANETS BY MASS

POSSIBLE TERRAQUEOUS PLANETS (LESS THAN 10 EARTH MASSES)

FIRST CONFIRMED EXOPLANET ORBITING A SUN-LIKE STAR (51 PEGAS)

PLANETS DISCOVERED

SOLAR SYSTEM

TO LIGHT-YEARS AWAY

EARTH

SATURN  
95 EARTHS

JUPITER  
318 EARTHS

HD 40308 b  
THE MOST MASSIVE  
(7.46 EARTHS)

## GIANTS

Massive Saturn and Jupiter are compared with the current crop of exoplanets. The largest of which a diameter has been measured is CT Cha b (artist's conception below). More than twice Jupiter's diameter and 17 times its mass, it orbits a young star, CT Cha, in the constellation Chameleon.

CT CHA b  
6,400 EARTHS  
MORE THAN 500 LIGHT-YEARS AWAY

## FINDING EXOPLANETS

Few of the planets discovered outside our solar system have been directly observed. Astrophysicists detect them and gather a remarkable amount of information by interpreting very subtle changes they cause in their star.

### DOPPLER WOBBLE

A star orbited by a planet will wobble because of gravitational pull. As the star moves slightly toward and then away from Earth, its light shifts in the spectrum to shorter or longer wavelengths. Measuring the degree of spectral shift reveals the planet's minimum mass.



### STAR SPECTRUM SEEN ON EARTH



### TRANSITS

A planet passing in front of a star minutely dims its light, revealing the planet's diameter, orbital period, and sometimes atmosphere.

### ASTROMETRY

The gravity of a very large planet pulls its star from side to side, far enough to be measured against background stars.

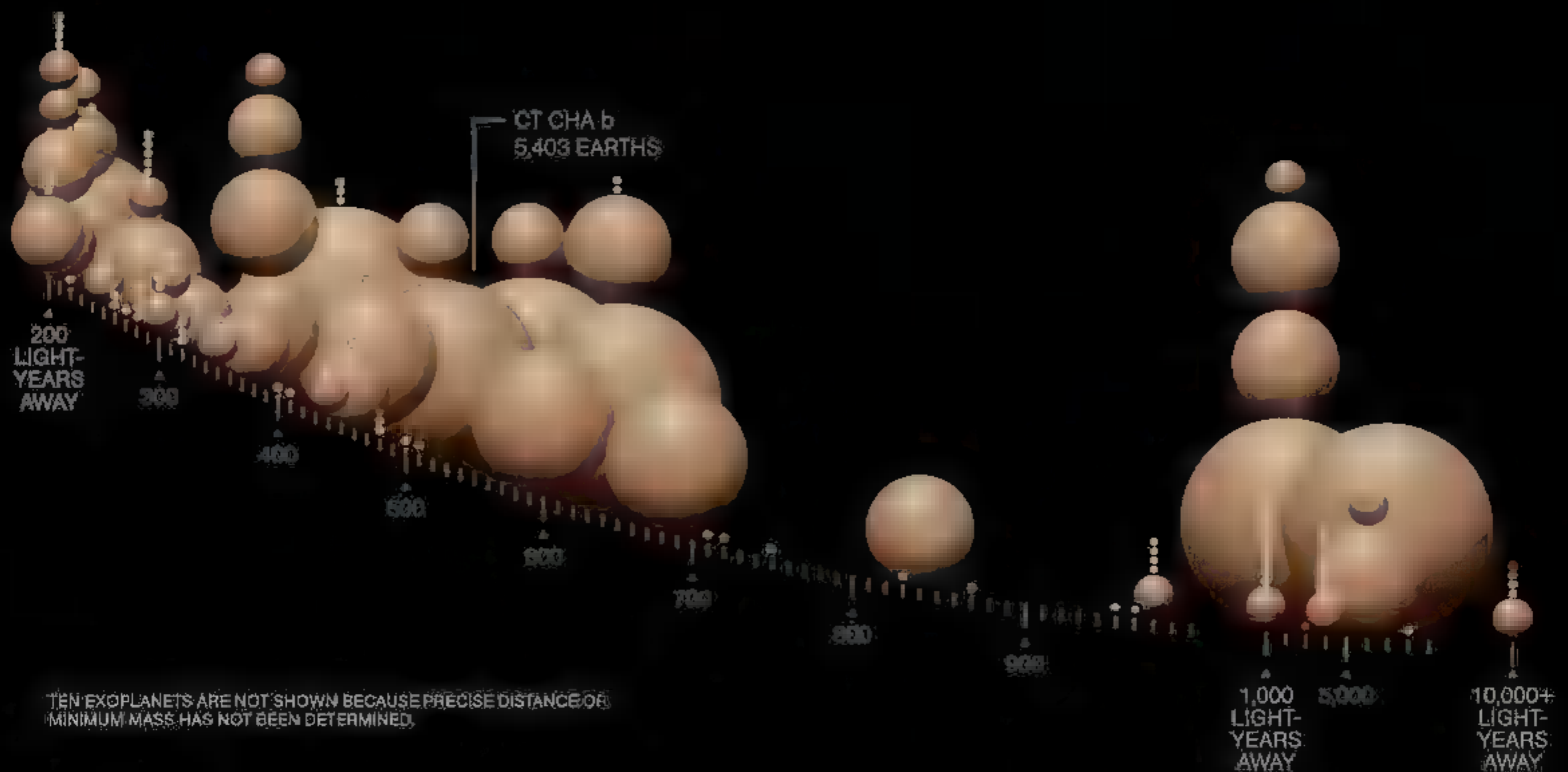


### DIRECT IMAGING

Blocking a star's light has yielded images of 11 planets, including Fomalhaut b and CT Cha b.

### GRAVITATIONAL MICROLENSING

If a star and planet pass in front of another star, their gravitational fields act as a lens, bending light from the far star in a distinctive way.



The launch that sent NASA's Kepler spacecraft streaking starward last March drew a crowd just south of Florida's Cape Canaveral. Kepler's mission is to keep watch over more than 100,000 candidate stars for signs of Earth-size planets.







WORLDS APART

# Seeking new earths

BY TIMOTHY FERRIS

**I**t took humans thousands of years to explore our own planet and centuries to comprehend our neighboring planets, but nowadays new worlds are being discovered every week. To date, astronomers have identified more than 370 “exoplanets,” worlds orbiting stars other than the sun. Many are so strange as to confirm the biologist J. B. S. Haldane’s famous remark that “the universe is not only queerer than we suppose, but queerer than we *can* suppose.” There’s an Icarus-like “hot Saturn” 260 light-years from Earth, whirling around its parent star so rapidly that a year there lasts less than three days. Circling another star 150 light-years out is a scorched “hot Jupiter,” whose upper atmosphere is being blasted off to form ■ gigantic, comet-like tail. Three benighted planets have been found orbiting a pulsar—the remains of a once mighty star shrunk into ■ spinning atomic nucleus the size of ■ city—while untold numbers of worlds have evidently fallen into their suns or been flung out of their systems to become “floaters” that wander in eternal darkness.

Amid such exoticia, scientists are eager for a hint of the familiar: planets resembling Earth,

orbiting their stars at just the right distance—neither too hot nor too cold—to support life as we know it. No planets quite like our own have yet been found, presumably because they're inconspicuous. To see a planet as small and dim as ours amid the glare of its star is like trying to see a firefly in a fireworks display; to detect its

**WE BELIEVE THAT BILLIONS OF SUCH PLANETS MUST EXIST AND THAT THEY HOLD THE PROMISE OF EXPANDING NOT ONLY THE SCOPE OF HUMAN KNOWLEDGE BUT ALSO THE RICHNESS OF THE HUMAN IMAGINATION.**

gravitational influence on the star is like listening for a cricket in a tornado. Yet by pushing technology to the limits, astronomers are rapidly approaching the day when they can find another Earth and interrogate it for signs of life.

Only 11 exoplanets, all of them big and bright and conveniently far away from their stars, have as yet had their pictures taken. Most of the others have been detected by using the spectroscopic Doppler technique, in which starlight is analyzed for evidence that the star is being tugged ever so slightly back and forth by the gravitational pull of its planets. In recent years astronomers have refined the Doppler technique so exquisitely that they can now tell when a star is pulled from its appointed rounds by only one meter a second—about human walking speed. That's sufficient to detect a giant planet in a big orbit, or a small one if it's very close to its star, but not an Earth at anything like our Earth's 93-million-mile distance from its star. The Earth tugs the sun around at only one-tenth

walking speed, or about the rate that an infant can crawl; astronomers cannot yet prize out so tiny a signal from the light of a distant star.

Another approach is to watch a star for the slight periodic dip in its brightness that will occur should an orbiting planet circle in front of it and block a fraction of its light. At most a tenth of all planetary systems are likely to be oriented so that these mini-eclipses, called transits, are visible from Earth, which means that astronomers may have to monitor many stars patiently to capture just a few transits. The French COROT satellite, now in the third and final year of its prime mission, has discovered seven transiting exoplanets, one of which is only 70 percent larger than Earth.

The United States' Kepler satellite is COROT's more ambitious successor. Launched from Cape Canaveral last March, Kepler is essentially just a big digital camera with a .95-meter aperture and a 95-megapixel detector. It makes wide-field pictures every 30 minutes, capturing the light of more than 100,000 stars in a single patch of sky between the bright stars Deneb and Vega. Computers on Earth monitor the brightness of all those stars over time, alerting humans when they detect the slight dimming that could signal the transit of a planet.

Because that dimming can be mimicked by other phenomena, such as the pulsations of a variable star or a large sunspot moving across a star's surface, the Kepler scientists won't announce the presence of a planet until they have seen it transit at least three times—a wait that may be only a few days or weeks for a planet rapidly circling close to its star but years for a terrestrial twin. By combining Kepler results with Doppler observations, astronomers expect to determine the diameters and masses of transiting planets. If they manage to discover a rocky planet roughly the size of Earth orbiting in the habitable zone—not so close to the star

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*Veteran stargazer Timothy Ferris writes from his own observatory in California. His new book, The Science of Liberty, will be published in February.*

that the planet's water has been baked away, nor so far out that it has frozen into ice—they will have found what biologists believe could be a promising abode for life.

The best hunting grounds may be dwarf stars, smaller than the sun. Such stars are plentiful (seven of the ten stars nearest to Earth are M dwarfs), and they enjoy long, stable careers, providing a steady supply of sunlight to any life-bearing planets that might occupy their habitable zones. Most important for planet hunters, the dimmer the star, the closer in its habitable zone lies—dim dwarf stars are like small campfires, where campers must sit close to be comfortable—so transit observations will pay off more quickly. A close-in planet also exerts a stronger pull on its star, making its presence easier to confirm with the Doppler method. Indeed, the most promising planet yet found—the “super Earth” Gliese 581 d, seven times Earth's mass—orbits in the habitable zone of a red dwarf star only a third the mass of the sun.

Should Earthlike planets be found within the habitable zones of other stars, a dedicated space telescope designed to look for signs of life there might one day take a spectrum of the light coming from each planet and examine it for possible biosignatures such as atmospheric methane, ozone, and oxygen, or for the “red edge” produced when chlorophyll-containing photosynthetic plants reflect red light. Directly detecting and analyzing the planet's own light, which might be one ten-billionth as bright as the star's, would be a tall order. But when a planet transits, starlight shining through the atmosphere could reveal clues to its composition that a space telescope might be able to detect.

While grappling with the daunting technological challenge of performing a chemical analysis of planets they cannot even see, scientists searching for extraterrestrial life must keep in mind that it may be very different from life here at home. The lack of the red edge, for instance, might not mean a terrestrial exoplanet is lifeless: Life thrived on Earth for billions of years before land plants appeared and populated the continents. Biological evolution is so inherently

unpredictable that even if life originated on a planet identical to Earth at the same time it did here, life on that planet today would almost certainly be very different from terrestrial life.

As the biologist Jacques Monod once put it, life evolves not only through necessity—the universal workings of natural law—but also through chance, the unpredictable intervention of countless accidents. Chance has reared its head many times in our planet's history, dramatically so in the many mass extinctions that wiped out millions of species and, in doing so, created room for new life-forms to evolve. Some of these baleful accidents appear to have been caused by comets or asteroids colliding with Earth—most recently the impact, 65 million years ago, that killed off the dinosaurs and opened up opportunities for the distant ancestors of human beings. Therefore scientists look not just for exoplanets identical to the modern Earth, but for planets resembling the Earth as it used to be or might have been. “The *modern* Earth may be the worst template we could use in searching for life elsewhere,” notes Caleb Scharf, head of Columbia University's Astrobiology Center.

It was not easy for earlier explorers to plumb the depths of the oceans, map the far side of the moon, or discern evidence of oceans beneath the frozen surfaces of Jovian moons, and it will not be easy to find life on the planets of other stars. But we now have reason to believe that billions of such planets must exist and that they hold the promise of expanding not only the scope of human knowledge but also the richness of the human imagination.

For thousands of years we humans knew so little about the universe that we were apt to celebrate our imaginations and denigrate reality. (As Spanish philosopher Miguel de Unamuno wrote, the mysticism of the religious visionaries of old arose from an “intolerable disparity between the hugeness of their desire and the smallness of reality.”) Now, with advances in science, it has become gallingly evident that nature's creativity outstrips our own. The curtain is going up on countless new worlds with stories to tell. □

**THEY GROW NO FOOD, RAISE NO LIVESTOCK, AND LIVE WITHOUT RULES OR CALENDARS. THEY ARE LIVING A HUNTER-GATHERER EXISTENCE THAT IS LITTLE CHANGED FROM 10,000 YEARS AGO. WHAT DO THEY KNOW THAT WE'VE FORGOTTEN?**

# **THE HADZA**

**BY MICHAEL FINKEL**

**PHOTOGRAPHS BY MARTIN SCHOELLER**

Like his ancestors, young Nija will grow up to roam the wildlands around Lake Eyasi in northern Tanzania—if outside pressures don't curtail his people's freedom first.





Long vistas and the dry season's withered vegetation enable keen eyes to spot game miles away. From a wind-bowed tree on a ridge, a man named Mahiya peers across rough terrain where Hadza traps range.





Everyone carries something from a kill site back to camp. For Kapala, it's the kudu's head atop his own. His group, composed of extended family and friends, will feast until all the meat is gone.





**“I’M HUNGRY,” SAYS ONWAS, SQUATTING BY HIS FIRE, BLINKING PLACIDLY THROUGH THE SMOKE. THE MEN BESIDE HIM MURMUR IN ASSENT. IT’S LATE AT NIGHT, DEEP IN THE EAST AFRICAN BUSH.**

Singing, a rhythmic chant, drifts over from the women’s camp. Onwas mentions a tree he spotted during his daytime travels. The men around the fire push closer. It is in a difficult spot, Onwas explains, at the summit of a steep hill that rises from the grassy plain. But the tree, he adds, spreading his arms wide like branches, is heavy with baobabs. There are more murmurs. Embers rise to a sky infinite with stars. And then it is agreed. Everyone stands and grabs his hunting bow.

Onwas is an old man, perhaps over 60—years are not a unit of time he uses—but thin and fit in the Hadza way. He’s maybe five feet tall. Across his arms and chest are the hieroglyphs of a lifetime in the bush: scars from hunts, scars from snakebites, scars from arrows and knives and scorpions and thorns. Scars from falling out of a baobab tree. Scars from a leopard attack. Half his teeth remain. He is wearing tire-tread sandals and tattered brown shorts. A hunting knife is strapped to his hip, in a sheath made of dik-dik hide. He’s removed his shirt, as have

most of the other men, because he wants to blend into the night.

Onwas looks at me and speaks for a few moments in his native language, Hadzane. To my ear it sounds strangely bipolar—lilting and gentle for a phrase or two, then jarring and percussive, with tongue clicks and glottic pops. It’s a language not closely related to any other that still exists: to use the linguists’ term, an isolate.

I have arrived in the Hadza homeland in northern Tanzania with an interpreter, a Hadza woman named Mariamu. She is Onwas’s niece. She attended school for 11 years and is one of only a handful of people in the world who can speak both English and Hadzane. She interprets Onwas’s words: Do I want to come?

Merely getting this far, to a traditional Hadza encampment, is not an easy task. Years aren’t the only unit of time the Hadza do not keep close track of—they also ignore hours and days and weeks and months. The Hadza language doesn’t have words for numbers past three or

Well past his prime as ■ hunter, but in full flower as a storyteller, Onwas is the father figure for one of the many groups of Hadza who still follow an ancient hunter-gatherer lifestyle.



four. Making an appointment can be a tricky matter. But I had contacted the owner of a tourist camp not far outside the Hadza territory to see if he could arrange for me to spend time with a remote Hadza group. While on a camping trip in the bush, the owner came across Onwas and asked him, in Swahili, if I might visit. The Hadza tend to be gregarious people, and Onwas readily agreed. He said I'd be the first foreigner ever to live in his camp. He promised to send his son to a particular tree at the edge of the bush to meet me when I was scheduled to arrive, in three weeks.

Sure enough, three weeks later, when my interpreter and I arrived by Land Rover in the bush, there was Onwas's son Ngaola waiting for us. Apparently, Onwas had noted the stages of the moon, and when he felt enough time had passed, he sent his son to the tree. I asked Ngaola if he'd waited a long time for me. "No," he said. "Only a few days."

At first, it was clear that everyone in camp—about two dozen Hadza, ranging from infants to grandparents—felt uncomfortable with my presence. There was a lot of staring, some nervous laughs. I'd brought along a photo album, and passing it around helped mitigate the awkwardness. Onwas was interested in a picture of my cat. "How does it taste?" he asked. One photo captured everyone's attention. It was of me participating in a New Year's Day polar bear swim, leaping into a hole cut in a frozen lake. Hadza hunters can seem fearless; Onwas regularly sneaks up on leopards and races after giraffes. But the idea of winter weather terrified him. He ran around camp with the picture, telling everyone I was a brave man, and this helped greatly with my acceptance. A man who can leap into ice, Onwas must have figured, is certainly a man who'd have no trouble facing a wild baboon. So on the third night of my stay, he asks if I want to join the hunting trip.

I do. I leave my shirt on—my skin does not blend well with the night—and I follow Onwas and ten other hunters and two younger boys out of camp in a single-file line. Walking through Hadza country in the dark is challenging; thornbushes and spiked acacia trees dominate the terrain, and even during the day there is no way to avoid being jabbed and scratched and punctured. A long trek in the Hadza bush can feel like receiving a gradual full-body tattoo. The Hadza spend a significant portion of their rest time digging thorns out of one another with the tips of their knives.

At night the thorns are all but invisible, and navigation seems impossible. There are no trails and few landmarks. To walk confidently in the bush, in the dark, without a flashlight, requires the sort of familiarity one has with, say, one's own bedroom. Except this is a thousand-square-mile bedroom, with lions and leopards and hyenas prowling in the shadows.

For Onwas such navigation is no problem. He has lived all his life in the bush. He can start a fire, twirling a stick between his palms, in less than 30 seconds. He can converse with a honeyguide bird, whistling back and forth, and be led directly to a teeming beehive. He knows everything there is to know about the bush and virtually nothing of the land beyond. One time I showed Onwas a map of the world. I spread it open on the dirt and anchored the corners with stones. A crowd gathered. Onwas stared. I pointed out the continent of Africa, then the country of Tanzania, then the region where he lived. I showed him the United States.

I asked him what he knew about America—the name of the president, the capital city. He said he knew nothing. He could not name the leader of his own country. I asked him, as politely as possible, if he knew anything about any country. He paused for a moment, evidently deep in

Men butcher small antelope called dik-diks near a hut in ■ traditional camp (top right). While men hunt, women crack baobab shells for the tart flesh within. Women's contributions of fruits and tubers are more vital than game in the Hadza diet. Several hundred out of a total Hadza population of about a thousand subsist almost exclusively on what they forage—despite long exposure to nearby agricultural societies.



## WHAT THE HADZA APPEAR TO OFFER—AND WHY THEY ARE OF GREAT INTEREST TO ANTHROPOLOGISTS—IS A GLIMPSE OF WHAT LIFE MAY HAVE BEEN LIKE BEFORE THE BIRTH OF AGRICULTURE.

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thought, then suddenly shouted, “London!” He couldn’t say precisely what London was. He just knew it was someplace not in the bush.

**A**bout a thousand Hadza live in their traditional homeland, a broad plain encompassing shallow, salty Lake Eyasi and sheltered by the ramparts of the Great Rift Valley. Some have moved close to villages and taken jobs as farmhands or tour guides. But approximately one-quarter of all Hadza, including those in Onwas’s camp, remain true hunter-gatherers. They have no crops, no livestock, no permanent shelters. They live just south of the same section of the valley in which some of the oldest fossil evidence of early humans has been found. Genetic testing indicates that they may represent one of the primary roots of the human family tree—perhaps more than 100,000 years old.

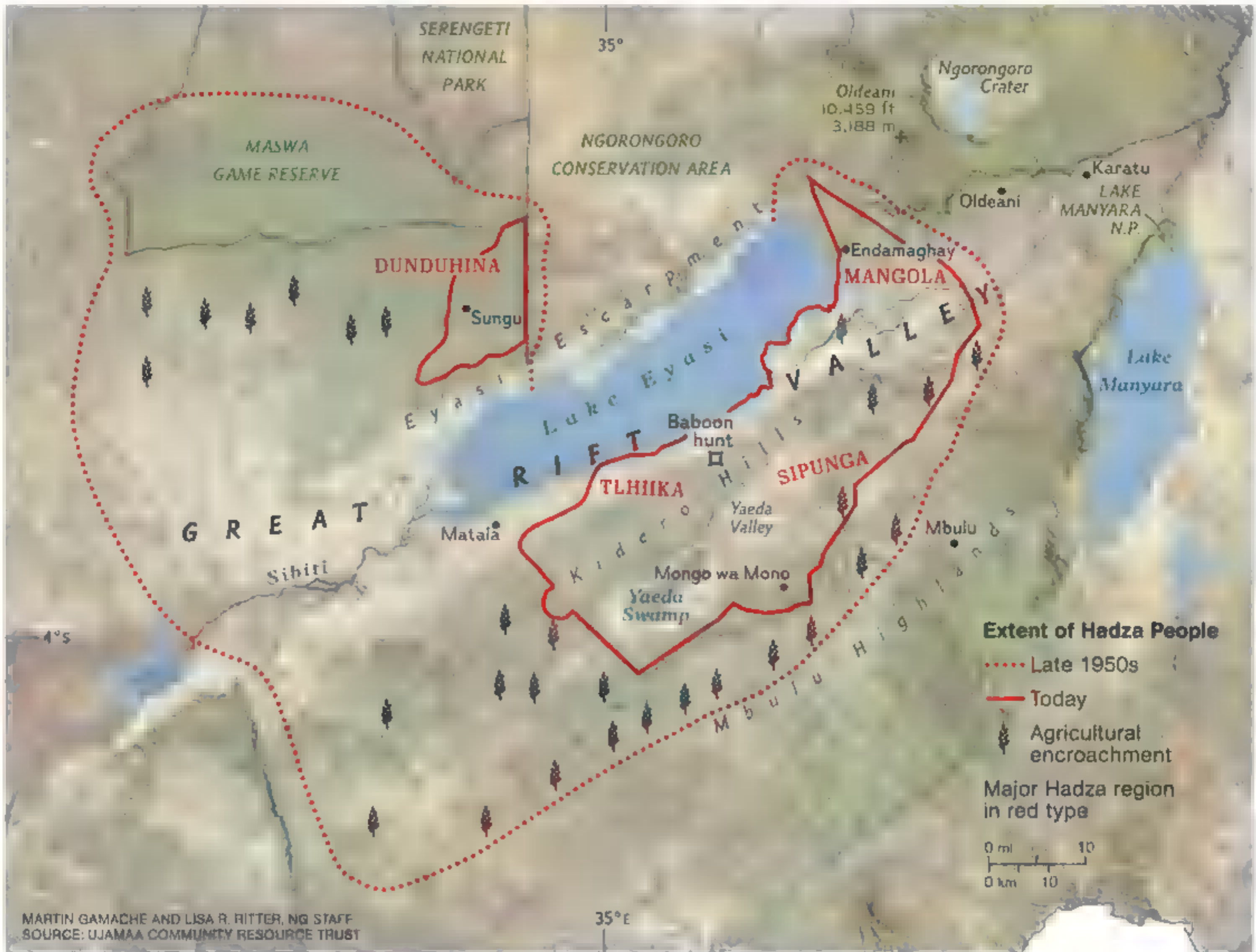
What the Hadza appear to offer—and why they are of great interest to anthropologists—is a glimpse of what life may have been like before the birth of agriculture 10,000 years ago. Anthropologists are wary of viewing contemporary hunter-gatherers as “living fossils,” says Frank Marlowe, a Florida State University professor of anthropology who has spent the past 15 years studying the Hadza. Time has not stood still for them. But they have maintained their foraging lifestyle in spite of long exposure to surrounding agriculturalist groups, and, says Marlowe, it’s possible that their lives have changed very little over the ages.

For more than 99 percent of the time since

the genus *Homo* arose two million years ago, everyone lived as hunter-gatherers. Then, once plants and animals were domesticated, the discovery sparked a complete reorganization of the globe. Food production marched in lockstep with greater population densities, which allowed farm-based societies to displace or destroy hunter-gatherer groups. Villages were formed, then cities, then nations. And in a relatively brief period, the hunter-gatherer lifestyle was all but extinguished. Today only a handful of scattered peoples—some in the Amazon, a couple in the Arctic, a few in Papua New Guinea, and a tiny number of African groups—maintain a primarily hunter-gatherer existence. Agriculture’s sudden rise, however, came with a price. It introduced infectious-disease epidemics, social stratification, intermittent famines, and large-scale war. Jared Diamond, the UCLA professor and writer, has called the adoption of agriculture nothing less than “the worst mistake in human history”—a mistake, he suggests, from which we have never recovered.

**T**he Hadza do not engage in warfare. They’ve never lived densely enough to be seriously threatened by an infectious outbreak. They have no known history of famine; rather, there is evidence of people from a farming group coming to live with them during a time of crop failure. The Hadza diet remains even today more stable and varied than that of most of the world’s citizens. They enjoy an extraordinary amount of leisure time. Anthropologists have estimated that they “work”—actively pursue food—four to six hours a day. And over all these thousands of years, they’ve left hardly more than a footprint on the land.

Traditional Hadza, like Onwas and his camp mates, live almost entirely free of possessions. The things they own—a cooking pot, a water container, an ax—can be wrapped in a blanket and carried over a shoulder. Hadza women gather berries and baobab fruit and dig edible tubers. Men collect honey and hunt. Nighttime baboon stalking is a group affair, conducted



**SHIFTING GROUND** The Hadza, who once moved freely over 4,000-plus square miles of the Great Rift Valley, are down to a quarter of their homeland as farms and livestock expand. Some Tanzanians see the group as an embarrassment for a modernizing nation.



only a handful of times each year; typically, hunting is a solo pursuit. They will eat almost anything they can kill, from birds to wildebeest to zebras to buffalo. They dine on warthog and bush pig and hyrax. They love baboon; Onwas joked to me that a Hadza man cannot marry until he has killed five baboons. The chief exception is snakes. The Hadza hate snakes.

The poison the men smear on their arrowheads, made of the boiled sap of the desert rose,

*Michael Finkel reported on Islam in Indonesia for our October issue. Award-winning photographer Martin Schoeller is best known for his close-up portraits.*

is powerful enough to bring down a giraffe. But it cannot kill a full-grown elephant. If hunters come across a recently dead elephant, they will crawl inside and cut out meat and organs and fat and cook them over a fire. Sometimes, rather than drag a large animal back to camp, the entire camp will move to the carcass.

Hadza camps are loose affiliations of relatives and in-laws and friends. Each camp has a few core members—Onwas's two sons, Giga and Ngaola, are often with him—but most others come and go as they please. The Hadza recognize no official leaders. Camps are traditionally named after a senior male (hence,

Onwas's camp), but this honor does not confer any particular power. Individual autonomy is the hallmark of the Hadza. No Hadza adult has authority over any other. None has more wealth; or, rather, they all have no wealth. There are few social obligations—no birthdays, no religious holidays, no anniversaries.

People sleep whenever they want. Some stay up much of the night and doze during the heat of the day. Dawn and dusk are the prime hunting times; otherwise, the men often hang out in camp, straightening arrow shafts, whittling bows, making bowstrings out of the ligaments of giraffes or impalas, hammering nails into arrowheads. They trade honey for the nails and for colorful plastic and glass beads that the women fashion into necklaces. If a man receives one as a gift, it's a good sign he has a female admirer.

There are no wedding ceremonies. A couple that sleeps at the same fire for a while may eventually refer to themselves as married. Most of the Hadza I met, men and women alike, were serial monogamists, changing spouses every few years. Onwas is an exception; he and his wife, Mille, have been with each other all their adult lives, and they have seven living children and several grandchildren. There was a bevy of children in the camp, with the resident grandmother, a tiny, cheerful lady named Nsalu, running a sort of day care while the adults were in the bush. Except for breast-feeding infants, it was hard to determine which kids belonged to which parents.

Gender roles are distinct, but for women there is none of the forced subservience knit into many other cultures. A significant number of Hadza women who marry out of the group soon return, unwilling to accept bullying treatment. Among the Hadza, women are frequently the ones who initiate a breakup—woe to the man who proves himself an incompetent hunter or treats his wife poorly. In Onwas's camp, some of the loudest, brashest members were women.

One in particular, Nduku, appointed herself my language teacher and spent a good percentage of every lesson teasing me mercilessly, often rolling around in laughter as I failed miserably at reproducing the distinct, tongue-tricky clicks.

Onwas knows of about 20 Hadza groups roaming the bush in his area, constantly swapping members, like a giant square dance. Most conflicts are resolved by the feuding parties simply separating into different camps. If a hunter brings home a kill, it is shared by everyone in his camp. This is why the camp size is usually no more than 30 people—that's the largest number who can share a good-size game animal or two and feel decently sated.

I was there during the six-month dry season, May through October, when the Hadza sleep in the open, wrapped in a thin blanket beside a campfire—two to six people at each hearth, eight or nine fires spread in a wide semicircle fronting a brush-swept common area. The sleep groupings were various: families, single men, young women (with an older woman as minder), couples. During the rainy season, they construct little domed shelters made of interwoven twigs and long grasses: basically, upside-down bird's nests. To build one takes no more than an hour. They move camp roughly once a month, when the berries run low or the hunting becomes tough or there's a severe sickness or death.

No one sleeps alone in Onwas's camp. He assigned his son Ngaola, the one who had waited a few days by the tree, to stay with me, and Ngaola recruited his friend Maduru to join us. The three of us slept in a triangle, head to toe to head around our fire, though when the mosquitoes were fierce, I slept in my tent.

Ngaola is quiet and introspective and a really poor hunter. He's about 30 years old and still unmarried; bedeviled, perhaps, by the five-baboon rule. It pains him that his older brother, Giga, is probably the most skilled archer in

Hadza women such as Samay are independent and powerful, free to marry or divorce at will. Scars on her cheeks may be from childhood cuts meant to curb crying—tears make cuts sting.

Following pages: As Ncolo (left) and his sister Sangu grow up, they will shoulder more adult duties.











camp. Maduru is a solid outdoorsman, an especially good honey finder, but something of a Hadza misfit. When a natural snakebite remedy was passed around camp, Maduru was left out of the distribution. This upset him greatly, and Onwas had to spend an hour beside him, an arm slung avuncularly over his shoulder, calming him down.

**M**aduru is the one who assumes responsibility for me during the nighttime baboon quest. As we move through the bush, he snaps off eye-level acacia branches with thorns the size of toothpicks and repeatedly checks to make sure I'm keeping pace. Onwas leads us to the hill where he'd seen the tree full of baboons.

Here we stop. There are hand signals, some clipped chatter. I'm unsure of what is going on—my translator has remained back at camp. The hunt is only for men. But Maduru taps me on the shoulder and motions for me to follow. The other hunters begin fanning out around the base of the hill, and I tail Maduru as he plunges into the brush and starts to climb. The slope seems practically vertical—hands are required to haul yourself up—and the thickets are as dense as Brillo pads. Thorns slice into my hands, my face. A trickle of blood oozes into my eye. We climb. I follow Maduru closely; I do not want to become separated.

Finally, I understand. We are climbing up, from all sides, toward the baboons. We are trying to startle them, to make them run. From the baboons' perch atop the hill, there is no place to go but down. The Hadza have encircled the hill; therefore, the baboons will be running toward the hunters. Possibly toward Maduru and me.

Have you ever seen a baboon up close? They have teeth designed for ripping flesh. An adult male can weigh more than 80 pounds. And here we are, marching upward, purposely trying to

provoke them. The Hadza are armed with bows and arrows. I have a pocketknife.

We move higher. Maduru and I break out of the undergrowth and onto the rocks. I feel as though I've emerged from beneath a blanket. There is a sickle of moon, a breeze. We are near the summit—the top is just over a stack of boulders, maybe 20 feet above our head. The baboon tree is up there, barely out of eyesight.

Then I hear it—a crazed screeching sound. The baboons are aware that something is amiss. The sound is piercing, panicked. I do not speak baboon, but it is not difficult to interpret. *Go away! Do not come closer!* But Maduru clambers farther, up onto a flat rock. I follow. The baboons are surrounded, and they seem to sense it.

Abruptly, there's a new sound. The crack of branches snapping overhead. The baboons are descending, shrieking. Maduru freezes, drops to one knee, slides an arrow into position, pulls back the bowstring. He is ready. I'm hiding behind him. I hope, I fervently hope, that no baboons run at us. I reach into my pocket, pull out my knife, unfold it. The blade is maybe two inches long. It feels ridiculous, but that is what I do.

The screeching intensifies. And then, directly over us, in stark silhouette against the backdrop of stars, is a baboon. Scrambling. Moving along the rock's lip. Maduru stands, takes aim, tracking the baboon from left to right, the arrow slotted, the bowstring at maximum stretch. Every muscle in my body tenses. My head pulses with panic. I grip my knife.

**T**he chief reason the Hadza have been able to maintain their lifestyle so long is that their homeland has never been an inviting place. The soil is briny; fresh water is scarce; the bugs can be intolerable. For tens of thousands of years, it seems, no one else wanted to live here. So the Hadza were left alone. Recently, however, escalating population pressures have brought a

A rugged life in the bush shows on the face of Moko, a skilled hunter. The striking genet-tail headdress could be a flourish to impress outsiders, or it may be a local fad—Hadza aren't immune to fashion.

flood of people into Hadza lands. The fact that the Hadza are such gentle stewards of the land has, in a way, hurt them—the region has generally been viewed by outsiders as empty and unused, a place sorely in need of development. The Hadza, who by nature are not a combative people, have almost always moved away rather than fight. But now there is nowhere to retreat.

There are currently cattle herders in the Hadza bush, and goat herders, and onion farmers, and corn growers, and sport hunters, and game poachers. Water holes are fouled by cow excrement. Vegetation is trampled beneath cattle's hooves. Brush is cleared to make way for crops; scarce water is used to irrigate them. Game animals have migrated to national parks, where the Hadza can't follow. Berry groves and trees that attract bees have been destroyed. Over the past century, the Hadza have lost exclusive possession of as much as 90 percent of their homeland.

None of the other ethnic groups living in the area—the Datoga, the Iraqw, the Isanzu, the Sukuma, the Iramba—are hunter-gatherers. They live in mud huts, often surrounded by livestock enclosures. Many of them look down on the Hadza and view them with a mix of pity and disgust: the untouchables of Tanzania. I once watched as a Datoga tribesman prevented several Hadza women from approaching a communal water hole until his cows had finished drinking.

Dirt roads are now carved into the edges of the Hadza bush. A paved road is within a four-day walk. From many high points there is decent cell phone reception. Most Hadza, including Onwas, have learned to speak some Swahili, in order to communicate with other groups. I was asked by a few of the younger Hadza hunters if I could give them a gun, to make it easier to harvest game. Onwas himself, though he's scarcely ventured beyond the periphery of the bush, senses that profound changes are coming. This does not appear to bother him. Onwas, as he repeatedly told me, doesn't worry about the future. He doesn't worry about anything. No Hadza I met, in fact, seemed prone to worry. It was a mind-set that astounded me, for the Hadza, to my way of thinking, have very

legitimate worries. *Will I eat tomorrow? Will something eat me tomorrow?* Yet they live a remarkably present-tense existence.

This may be one reason farming has never appealed to the Hadza—growing crops requires planning; seeds are sown now for plants that won't be edible for months. Domestic animals must be fed and protected long before they're ready to butcher. To a Hadza, this makes no sense. Why grow food or rear animals when it's being done for you, naturally, in the bush? When they want berries, they walk to a berry shrub. When they desire baobab fruit, they visit a baobab tree. Honey waits for them in wild hives. And they keep their meat in the biggest storehouse in the world—their land. All that's required is a bit of stalking and a well-shot arrow.

There are other people, however, who do ponder the Hadza's future. Officials in the Tanzanian government, for starters. Tanzania is a future-oriented nation, anxious to merge into the slipstream of the global economy. Baboon-hunting bushmen is not an image many of the country's leaders wish to project. One minister has referred to the Hadza as backward. Tanzania's president, Jakaya Kikwete, has said that the Hadza "have to be transformed." The government wants them schooled and housed and set to work at proper jobs.

Even the one Hadza who has become the group's de facto spokesperson, a man named Richard Baalow, generally agrees with the government's aims. Baalow, who adopted a non-Hadza first name, was one of the first Hadza to attend school. In the 1960s his family lived in government-built housing—an attempt at settling the Hadza that soon failed. Baalow, 53, speaks excellent English. He wants the Hadza to become politically active, to fight for legal protection of their land, and to seek jobs as hunting guides or park rangers. He encourages Hadza children to attend the regional primary school that provides room and board to Hadza students during the academic year, then escorts them back to the bush when school is out.

The school-age kids I spoke with in Onwas's group all said they had no interest in sitting in

a classroom. If they went to school, many told me, they'd never master the skills needed for survival. They'd be outcasts among their own people. And if they tried their luck in the modern world—what then? The women, perhaps, could become maids; the men, menial laborers. It's far better, they said, to be free and fed in the bush than destitute and hungry in the city.

More Hadza have moved to the traditionally Hadza area of Mangola, at the edge of the bush, where, in exchange for money, they demonstrate their hunting skills to tourists. These Hadza have proved that their culture is of significant interest to outsiders and a potential source of income. Yet among the Hadza of Mangola there has also been a surge in alcoholism, an outbreak of tuberculosis, and a distressing rise in domestic violence, including at least one report of a Hadza man who beat his wife to death.

Though the youngsters in Onwas's group show little interest in the outside world, the world is coming to them. After two million years, the age of the hunter-gatherer is over. The Hadza may hold on to their language; they may demonstrate their abilities to tourists. But it's only a matter of time before there are no more traditional Hadza scrambling in the hills with their bows and arrows, stalking baboons.

**U**p on the hill Onwas has led us to, clutching my knife, I crouch behind Maduru as the baboon moves along a fin of rock. And then, abruptly, the baboon stops. He swivels his head. He is so close we could reach out to each other and make contact. I stare into his eyes, too frightened to even blink. This lasts maybe a second. Maduru doesn't shoot, possibly because the animal is too close and could attack us if wounded—it's often the poison, not the arrow, that kills. An instant later the baboon leaps away into the bushes.

There is silence for a couple of heartbeats. Then I hear frantic yelping and crashing. It's coming from the far side of the rock, and I can't tell if it is human or baboon. It's both. We thrash through bushes, half-tumbling, half-running,

**EVER SEEN A BABOON  
UP CLOSE? THEIR TEETH ARE  
DESIGNED FOR RIPPING FLESH.  
AND WE ARE PROVOKING THEM.  
THE HADZA ARE ARMED WITH  
BOWS AND ARROWS.  
I HAVE A POCKETKNIFE.**

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until we reach a clearing amid a copse of acacias.

And there it is: the baboon. On his back, mouth open, limbs splayed. Shot by Giga. A nudge with a toe confirms it—dead. Maduru whistles and shouts, and soon the other hunters arrive. Onwas kneels and pulls the arrow out of the baboon's shoulder and hands it back to Giga. The men stand around the baboon in a circle, examining the kill. There is no ceremony. The Hadza are not big on ritual. There is not much room in their lives, it seems, for mysticism, for spirits, for pondering the unknown. There is no specific belief in an afterlife—every Hadza I spoke with said he had no idea what might happen after he died. There are no Hadza priests or shamans or medicine men. Missionaries have produced few converts. I once asked Onwas to tell me about God, and he said that God was blindingly bright, extremely powerful, and essential for all life. God, he told me, was the sun.

The most important Hadza ritual is the *epeme* dance, which takes place on moonless nights. Men and women divide into separate groups. The women sing while the men, one at a time, don a feathered headdress and tie bells around their ankles and strut about, stomping their right foot in time with the singing. Supposedly, on *epeme* nights, ancestors emerge from the bush and join the dancing. One night when I watched the *epeme*, I spotted a teenage boy, Mataiyo, sneak into the bush with a young woman. Other men fell asleep after their turn dancing. Like almost every aspect of Hadza life, the ceremony was informal, with a strictly individual choice of how deeply to participate.



A hunting party tracks a warthog that's been shot, scouting the blood trail using skills passed down through generations. Here, near the edge of the Serengeti Plain, Hadza hunters also take bigger game such as giraffe. The successful Bowman, Garach (at right), will share much of the warthog meat.





With the Hadza god not due to rise for several hours, Giga grabs the baboon by a rear paw and drags the animal through the bush back to camp. The baboon is deposited by Onwas's fire, while Giga sits quietly aside with the other men. It is Hadza custom that the hunter who's made the kill does not show off. There is a good deal of luck in hunting, and even the best archers will occasionally face a long dry spell. This is why the Hadza share their meat communally.

Onwas's wife, Mille, is the first to wake. She's wearing her only set of clothes, a sleeveless T-shirt and a flower-patterned cloth wrapped about her like a toga. She sees the baboon, and with the merest sign of pleasure, a brief nod of her chin, she stokes the fire. It's time to cook. The rest of camp is soon awake—everyone is hungry—and Ngaola skins the baboon and stakes out the pelt with sharpened twigs. The skin will be dry in a few days and will make a fine sleeping mat. A couple of men butcher the animal, and cuts of meat are distributed. Onwas, as camp elder, is handed the greatest delicacy: the head.

The Hadza cooking style is simple—the meat is placed directly on the fire. No grill, no pan. Hadza mealtime is not an occasion for politeness. Personal space is generally not recognized; no matter how packed it is around a fire, there's always room for one more, even if you end up on someone's lap. Once a cut of meat has finished cooking, anyone can grab a bite.

And I mean grab. When the meat is ready, knives are unsheathed and the frenzy begins. There is grasping and slicing and chewing and pulling. The idea is to tug at a hunk of meat with your teeth, then use your knife to slice away your share. Elbowing and shoving is standard behavior. Bones are smashed with rocks and the marrow sucked out. Grease is rubbed on the skin as a sort of moisturizer. No one speaks a word, but the smacking of lips and gnashing of teeth is almost comically loud.

I'm ravenous, so I dive into the scrum and snatch up some meat. Baboon steak, I have to say, isn't terrible—a touch gamy, but it's been a few days since I've eaten protein, and I can feel my body perking up with every bite. Pure

**I ENVY HOW FREE  
THE HADZA APPEAR TO BE.  
FREE FROM POSSESSIONS AND  
MOST SOCIAL DUTIES.  
FREE FROM SCHEDULES, JOBS,  
BOSSSES, LAWS, NEWS, MONEY.  
FREE FROM WORRY.**

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fat, rather than meat, is what the Hadza crave, though most coveted are the baboon's paw pads. I snag a bit of one and pop it in my mouth, but it's like trying to swallow a pencil eraser. When I spit the gob of paw pad out, a young boy instantly picks it up and swallows it.

Onwas, with the baboon's head, is comfortably above the fray. He sits cross-legged at his fire and eats the cheeks, the eyeballs, the neck meat, and the forehead skin, using the soles of his sandals as a cutting board. He gnaws the skull clean to the bone, then plunges it into the fire and calls me and the hunters over for a smoke.

It is impossible to overstate just how much Onwas—and most Hadza—love to smoke. The four possessions every Hadza man owns are a bow, some arrows, a knife, and a pipe, made from a hollowed-out, soft stone. The smoking material, tobacco or cannabis, is acquired from a neighboring group, usually the Datoga, in exchange for honey. Onwas has a small amount of tobacco, which is tied into a ball inside his shirttail. He retrieves it, stuffs it all into his pipe, and then, holding the pipe vertically, plucks an ember from the fire and places it atop his pipe. Pulsing his cheeks in and out like a bellows, he inhales the greatest quantity of smoke he possibly can. He passes the pipe to Giga.

Then the fun begins. Onwas starts to cough,

slowly at first, then rapidly, then uncontrollably with tears bursting from his eyes, then with palms pushing against his head, and then, finally, rolling onto his back, spitting and gasping for air. In the meantime, Giga has begun a similar hacking session and has passed the pipe to Maduru, who then passes the pipe to me. Soon, all of us, the whole circle of men, are hacking and crying and rolling on our backs. The smoke session ends when the last man sits up, grinning, and brushes the dirt from his hair.

With the baboon skull still in the fire, Onwas rises to his feet and claps his hands and begins to speak. It's a giraffe-hunting story—Onwas's favorite kind. I know this even though Mariamu, my translator, is not next to me. I know because Onwas, like many Hadza, is a story performer. There are no televisions or board games or books in Onwas's camp. But there is entertainment. The women sing songs. And the men tell campfire stories, the Kabuki of the bush.

Onwas elongates his neck and moves around on all fours when he's playing the part of the giraffe. He jumps and ducks and pantomimes shooting a bow when he's illustrating his own role. Arrows whoosh. Beasts roar. Children run to the fire and stand around, listening intently; this is their schooling. The story ends with a dead giraffe—and as a finale, a call and response.

"Am I a man?" asks Onwas, holding out his hands.

"Yes!" shouts the group. "You are a man."

"Am I a man?" asks Onwas again, louder.

"Yes!" shouts the group, their voices also louder. "You are a man!"

Onwas then reaches into the fire and pulls out the skull. He hacks it open, like a coconut, exposing the brains, which have been boiling for a good hour inside the skull. They look like ramen noodles, yellowish white, lightly steaming. He holds the skull out, and the men,

Baboon hunters (top right) team up to haul quarry back to camp at sunrise. Arrows tipped with poison from desert rose plants help bring down prey. Tissue near wounds is excised so diners don't ingest the toxin. The arrival of meat in camp may spur a line dance (bottom right), but the Hadza also dance deep in the night as a ritual or at any hour for sheer pleasure.



including myself, surge forward and stick our fingers inside the skull and scoop up a handful of brains and slurp them down. With this, the night, at last, comes to an end.

**T**he baboon hunt, it seems, was something of an initiation for me. The next day, Nyudu hacks down a thick branch from a *mutateko* tree, then carefully carves a bow for me, long and gracefully curved. Several other men make me arrows. Onwas presents me with a pipe. Nkulu handles my shooting lessons. I begin to carry my bow and arrows and pipe with me wherever I go (along with my water-purification kit, my sunscreen, my bug spray, and my eyeglass-cleaning cloth).

I am also invited to bathe with the men. We walk to a shallow, muddy hole—more of a large puddle, with lumps of cow manure bobbing about—and remove our clothes. Handfuls of mud are rubbed against the skin as an exfoliant, and we splash ourselves clean. While Hadza have a word for body odor, the men tell me that they prefer their women not to bathe—the longer they go between baths, they say, the more attractive they are. Nduku, my Hadza language teacher, said she sometimes waits months between baths, though she can't understand why her husband wants her that way. I also discover, by listening to Mille and Onwas, that bickering with one's spouse is probably a universal human trait. "Isn't it your turn to fetch water?" "Why are you napping instead of hunting?" "Can you explain why the last animal brought to camp was skinned so poorly?" It occurs to me that these same arguments, in this same valley, have been taking place for thousands of years.

There are things I envy about the Hadza—mostly, how free they appear to be. Free from possessions. Free of most social duties. Free from religious strictures. Free of many family responsibilities. Free from schedules, jobs, bosses,

bills, traffic, taxes, laws, news, and money. Free from worry. Free to burp and fart without apology, to grab food and smoke and run shirtless through the thorns.

But I could never live like the Hadza. Their entire life, it appears to me, is one insanely committed camping trip. It's incredibly risky. Medical help is far away. One bad fall from a tree, one bite from a black mamba snake, one lunge from a lion, and you're dead. Women give birth in the bush, squatting. About a fifth of all babies die within their first year, and nearly half of all children do not make it to age 15. They have to cope with extreme heat and frequent thirst and swarming tsetse flies and malaria-laced mosquitoes.

The days I spent with the Hadza altered my perception of the world. They instilled in me something I call the "Hadza effect"—they made me feel calmer, more attuned to the moment, more self-sufficient, a little braver, and in less of a constant rush. I don't care if this sounds maudlin: My time with the Hadza made me happier. It made me wish there was some way to prolong the reign of the hunter-gatherers, though I know it's almost certainly too late.

It was my body, more than anything, that let me know it was time to leave the bush. I was bitten and bruised and sunburned and stomach-achy and exhausted. So, after two weeks, I told everyone in camp I had to go.

There was little reaction. The Hadza are not sentimental like that. They don't do extended goodbyes. Even when one of their own dies, there is not a lot of fuss. They dig a hole and place the body inside. A generation ago, they didn't even do that—they simply left a body out on the ground to be eaten by hyenas. There is still no Hadza grave marker. There is no funeral. There's no service at all, of any sort. This could be a person they had lived with their entire life. Yet they just toss a few dry twigs on top of the grave. And they walk away. □

Holo, Onwas's daughter, will raise her own five children in intimate touch with the land that supports them.

Curiously indifferent to most vestiges of modernity, the Hadza continue to survive on their own terms.



LOVE

IS

IN

THE

AIR

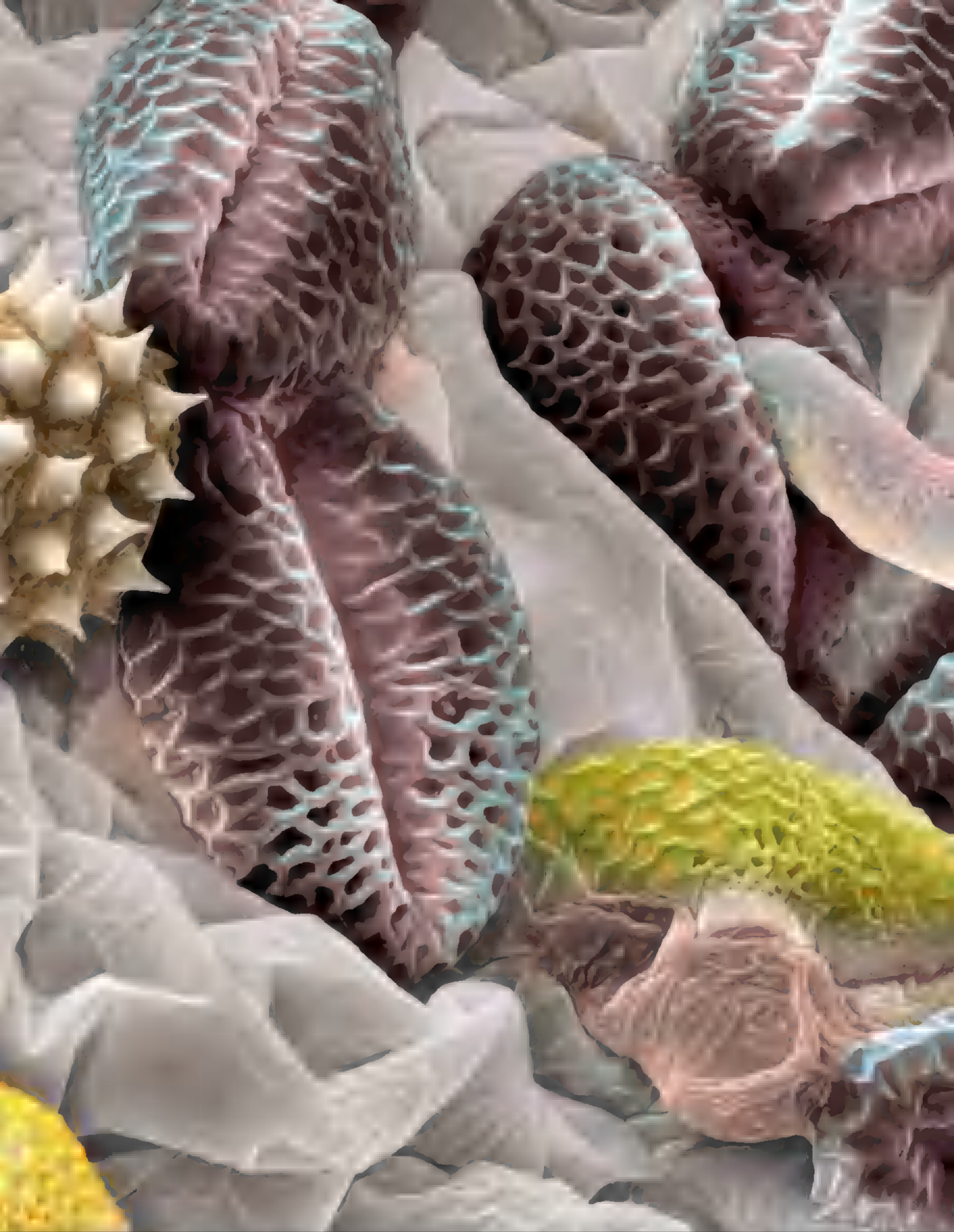
*Birds do it, bees do it, even pollinating plants do it.*





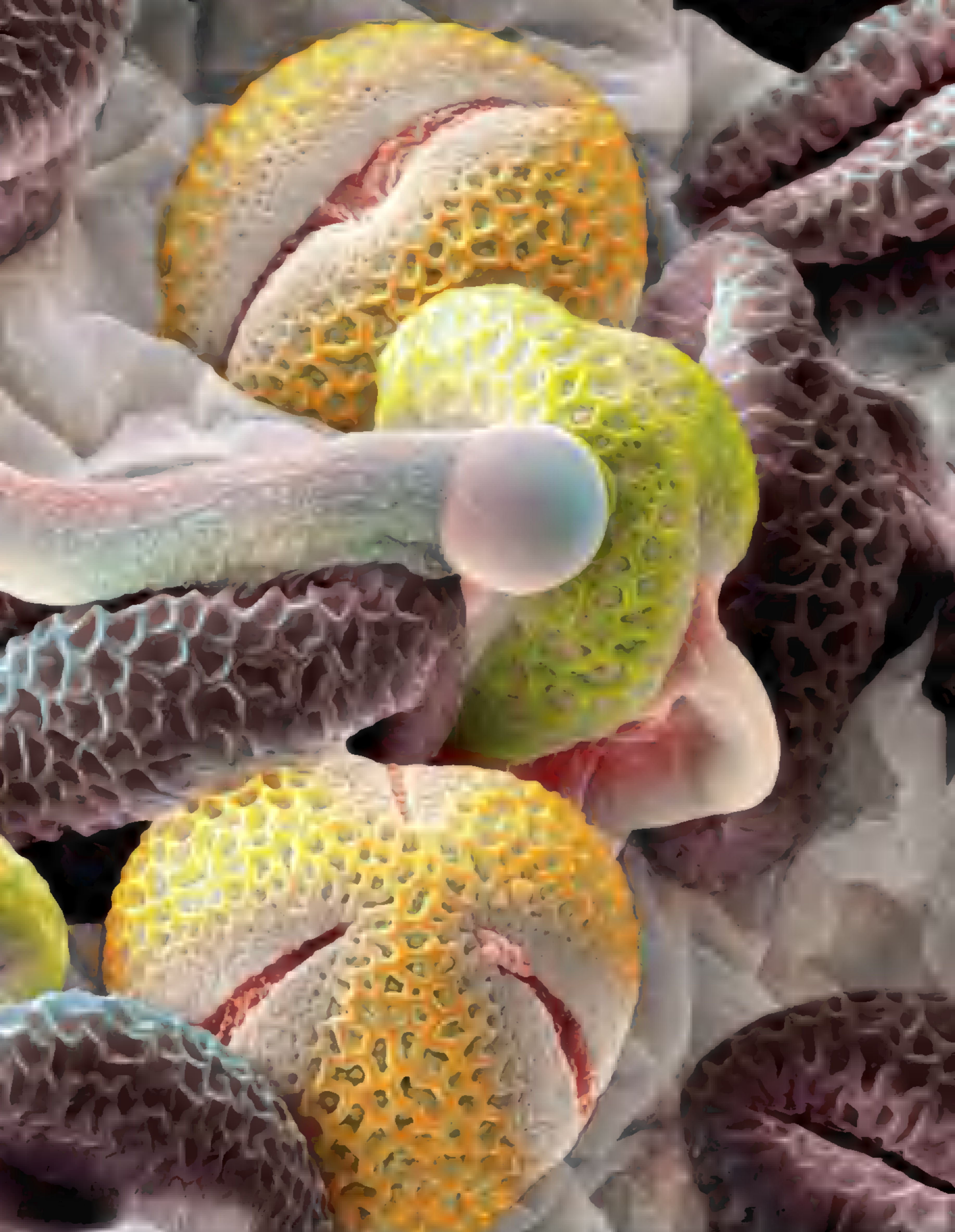
### **Geranium**

The size of the grains measured in millionths of a meter, but the romantic journeys of pollen are epic. The dozens of golden grains that have successfully reached a *Geranium phaeum* flower's stigma must compete to be among the few that achieve fertilization.



Snowball blossom





Lodged in the ruffled tissue of a *Viburnum tinus* stigma, pollen grains from other snowball blossoms (gray) swell with moisture. One (at center) is already growing the tube that delivers sperm to the ovule. Other species' pollen (yellow and green) has landed amiss; genetic defenses exclude them from the fertilization race.

**By Rob Dunn**

**Photographs by Martin Oeggerli**



As humans we take many things for granted. One is surely the ability to walk, crawl, or even, after a little too much to drink, drag ourselves over to a lovely member of the opposite sex. Plants have no such luxury. For much of the long history of green

life on land, plants had to be near each other, touching almost, to mate. Moss lets its pale sperm into rainwater to float to nearby partners, as did other early plants, but this method requires moisture. Vegetation could only survive in those damp corners where beads of water connected, dependably, a male to a female. Most of the Earth was brown.

Then one day more than 375 million years ago, it happened. One lineage of plants evolved pollen grains and seeds, and from then on nothing was the same. Let's not mince words. Pollen is plant sperm—two individuals per grain—surrounded by a single, often golden, wall that offers both protection and chariot. If the tension in the long story of plants was the distance between lovers, pollen was what would bring them together, over feet or even across continents. It was an evolutionary trick that transformed the world by letting strangers have sex.

Life remained a long shot. Pollen lunged into gusts of wind on the chance that a few grains would find their mark. With time came more contrivances. Pollen sacks burst, propelling the grains. Pollen evolved balloon-like wings to catch the breeze. Plants began to produce thousands, millions, billions of individual grains. They made many that one might succeed.

The target that each of those billions of pollen grains aims for is the naked ovule (the future seed) of another plant of the same species. At the ovule, which contains an egg cell, the pollen grain attempts to initiate a tube to connect sperm and egg. If the pollen lands on the wrong species of plant or is too weak or old, the tube does not form. But every so often it does, and then one of the two sperm, the chosen one, travels to fertilization, and a viable seed develops. That there are plants at all is testament to the more than occasional success of this intimate, improbable lottery.

Life proceeded like this, with pollen carried by wind and chance to ovules, for millions of years, until things changed again—"a soundless, violent explosion," the naturalist Loren Eiseley called it. In one lineage, individuals evolved seeds protected in fruits and surrounded by petals. That lineage, the angiosperms, did better because their ovules were protected (in ovaries, which turn into fruit), and because the petals attracted animals that, however accidentally,

The images in this story were made with a scanning electron microscope, which uses beams of electrons to trace the surfaces of objects. The resulting 3-D images, originally black-and-white, were enhanced with color.



**Willow** A grain of *Salix caprea* pollen has missed its mark. Wedged between flower petals, it will die. While some grains will be flung into the air as springtime breezes swirl the willow leaves, others will stick to the backs of bees and find their way.

**Pollen, and ultimately flowers, led to explosive diversification in plants, turning a brown planet green and then red, yellow, white, orange, and all the rest.**

carried pollen on feathers, skin, or hair. Animals carried pollen from flower to flower more consistently than did wind, so plants with attractive petals were favored. Flowers evolved many colors to woo and nectar, an additional lure. Animals came in the thousands. Hummingbirds and honeycreepers evolved long beaks to reach nectar. Moths, bees, and flies evolved long, sucking mouthparts. Bats evolved long, sticky tongues—some of them nearly twice as long as their bodies.

The nectar-gathering animals disperse pollen at the same time. Foraging bumblebees collect pollen on tiny hairs while they bump around in



Pollen comes in many forms and sizes. The diameter of ■ pumpkin pollen grain (at center) is as thick as a dollar bill. The tiny speck at its lower right is a grain of forget-me-not pollen.

flowers drinking, and deposit that pollen at the same time as they buzz among flowers. Then they go one further by scraping some collected pollen into tiny baskets, corbiculae, on their rear legs. Once home, the bees store the pollen in pots they make out of wax, keeping it to eat on rainy days.

In allowing plants to have sex at a distance, pollen, and ultimately flowers, led to explosive diversification, turning a brown planet green and then red, yellow, white, orange, and all the rest. Pollen diversified too. In the 300,000 pollen-bearing plant species on Earth, there are 300,000 different forms of pollen. The great variety in colors, shapes, and textures of the grains has evolved in accordance with each plant's biological particulars. Beetle-pollinated plants tend to have smooth, sticky pollen, the better to adhere to the lumbering beetles' backs. Plants pollinated by fast-moving bees or flies may have spiny pollen that lodges easily between the insects' hairs. Plants pollinated by bigger animals, such as bats, sometimes have bigger pollen, though not always—perhaps not even most of the time. In the details of pollen's variety, more remains to be explained than is understood.

The most recent story in the history of pollen is recorded not by the successes but by the failures. The air, however clear, is full of unsuccessful pollen, drifting in eddies of wind. Billions of grains reach the stratosphere. Even now, as you read, a few grains may rest on your hands or face, or on your cat. Pollen settles and accumulates in sediment, layer after layer, particularly at the bottoms of lakes and ponds.

In those layers, where decay is slow, pollen constitutes a history book far outlasting the plants that produce it. Grass pollen in sediment means grasslands, pine pollen indicates pine forests, and so on—an encyclopedia of detail spelled out in the mud. Palynologists take core samples of lake-bottom layers to examine shifts in the species of plants from one layer to the next. Collectively such chronicles of changing plant life can span thousands of years or more.

Scientists studying the pollen in core samples

see changes in the frequency of fires, the retreat and expansion of species with glaciations, and more. But the biggest change in millennia has come recently, a measure of the march of human technologies. With the spread of agriculture, tree pollen has, spring after spring, grown less common and the pollen of cereals and weeds more so. As we change Earth's climate, species long adapted to the cold will become rarer, and the pollen of new arrivals from warmer regions will increase. As we fly around the world, the pollen of Asian species is turning up in North America, of African species in Hawaii, of Australian species in South Africa.

Pollen has tracked the progress of civilizations before. In the Maya lowlands of Guatemala, the pollen of forest trees was once the most common. Around 4,600 years ago, corn pollen started to appear. By 2,000 years ago, most pollen came from plants associated with agriculture.

Then around a thousand years ago, corn pollen began to disappear. Weed pollen too. Eventually, the pollen of trees came back. In seeing this change, palynologists can infer much of the rest. The birds also came back, as did the bees and even the bats with their long, sticky tongues. Like all records, the record of pollen has biases, but here the big message needs little interpretation. The civilization rose and then faded—the temples giving way to the scramble of roots and the rise of trees with their pendulant flowers and abundant pollen, which was cast once more into the air and onto animals' wiggling backs. Whatever happens to us in the years to come, the pollen will continue to record. It offers no criticism, just testament.

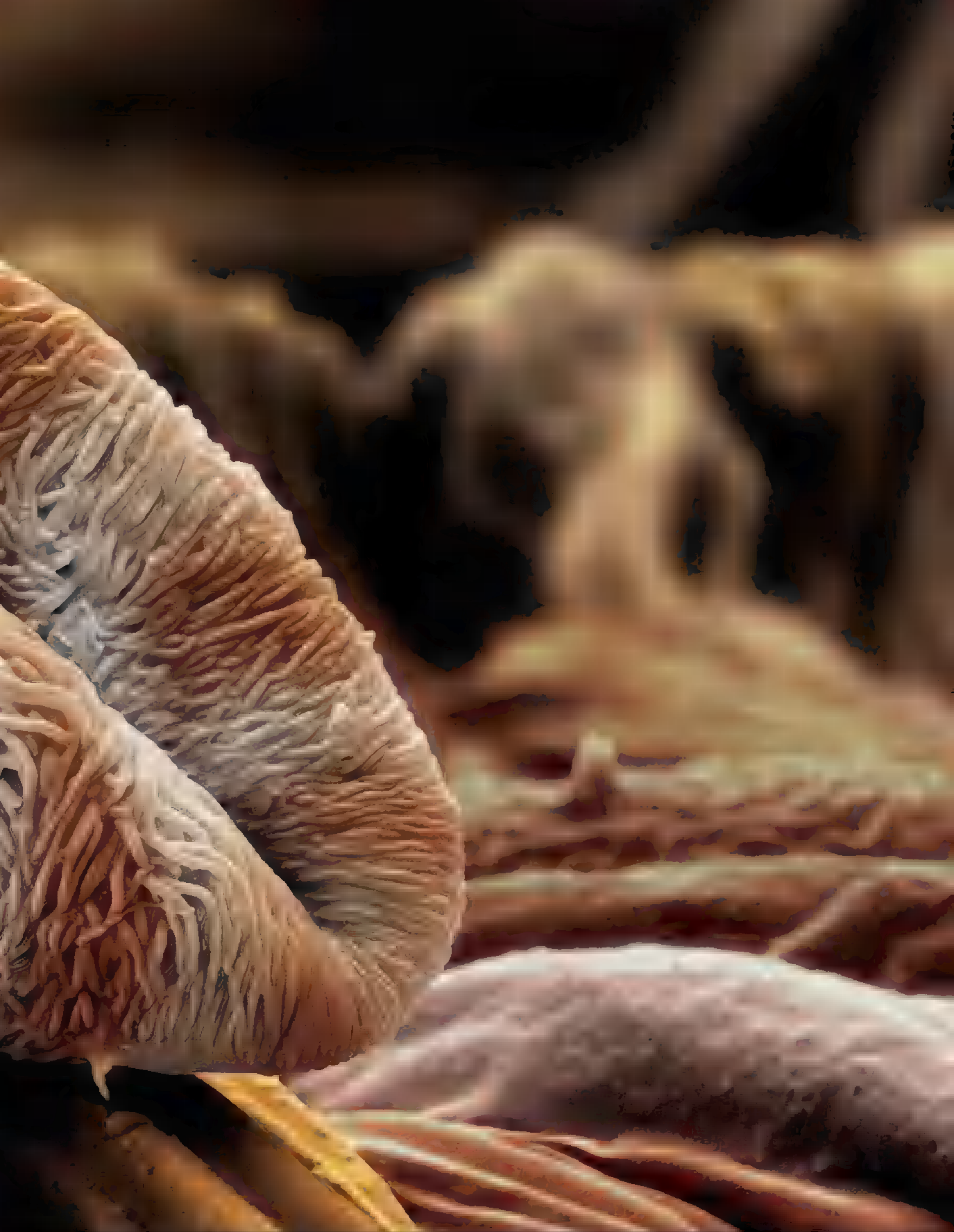
All life, including our own, is improbable, but somehow the lives of plants, dependent on pollen's traffic, are particularly so. And yet they find each other again and again, as they have since before the days of the dinosaurs, when giant dragonflies cruised the air, yellow dust no doubt stuck in their prehistoric hair. □

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*Ecologist Rob Dunn, author of Every Living Thing, is a professor at North Carolina State University. Martin Oeggerli is a Swiss molecular biologist.*



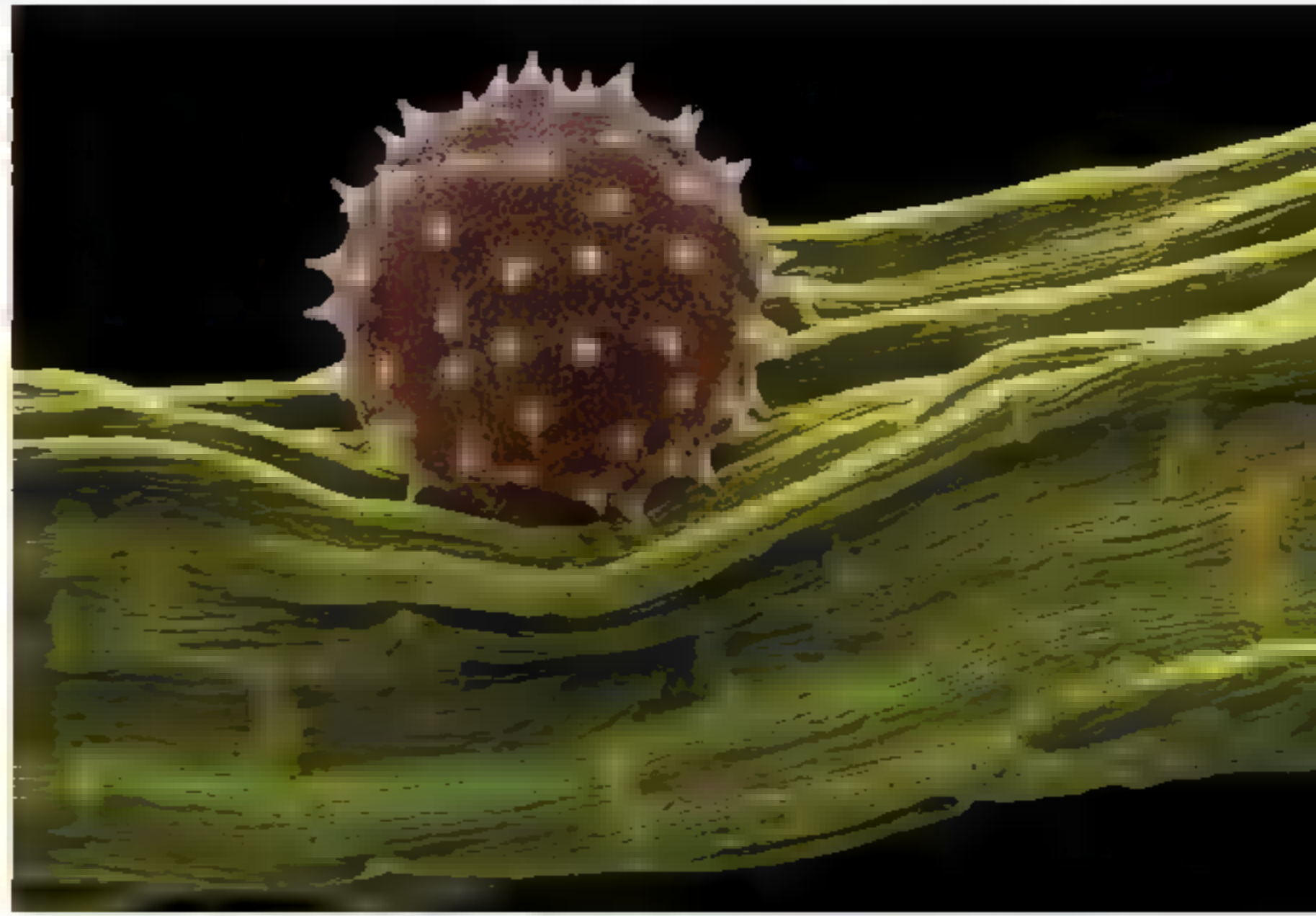
Flowering quince



The convoluted surface of *Chaenomeles* sp. pollen may speed up moisture absorption when the grain lands on a target bloom. "Quick hydration means faster formation of the pollen tube," says Swiss photographer Martin Oeggerli, a postdoctoral fellow at University Hospital Basel. "That's important for fertilization."



**White clover** *TRIFOLIUM REPENS*



**Indian mallow** *ABUTILON PICTUM*



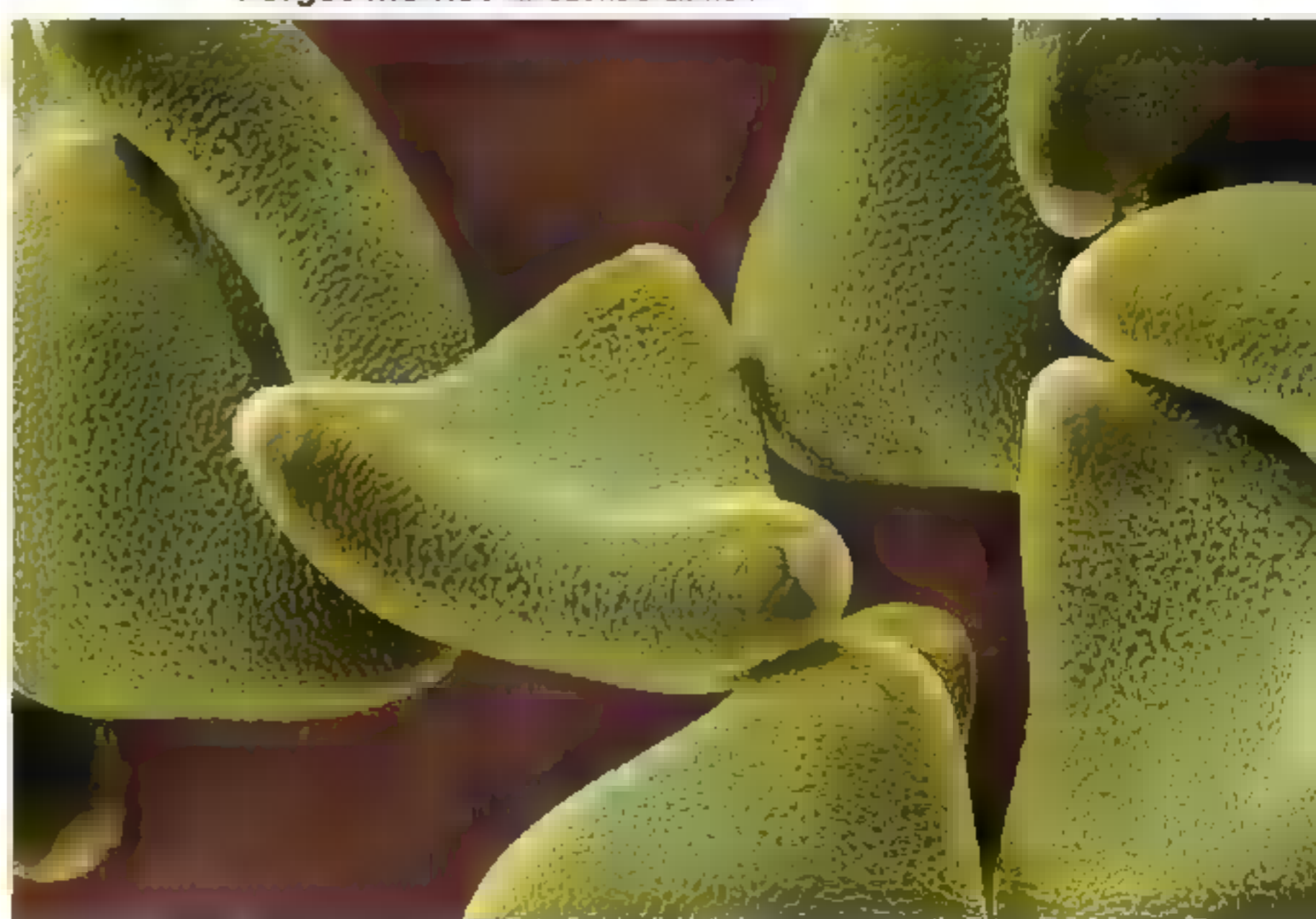
**Water cabbage** *PISTIA STRATIOTES*



**Forget-me-not** *MYOSOTIS SYLVATICA*

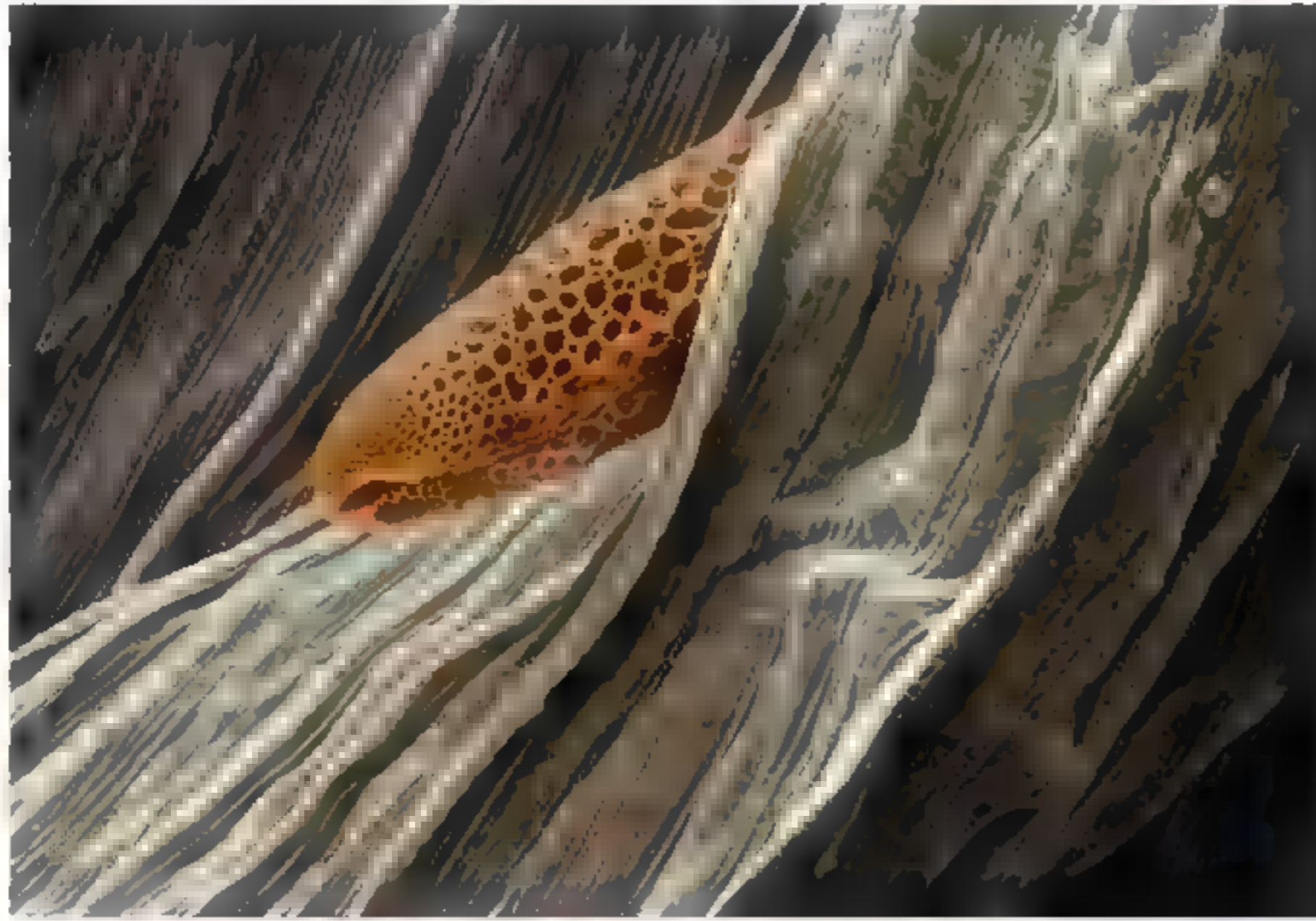


**Persian silk tree** *ALBIZIA JULIBRISSIN*

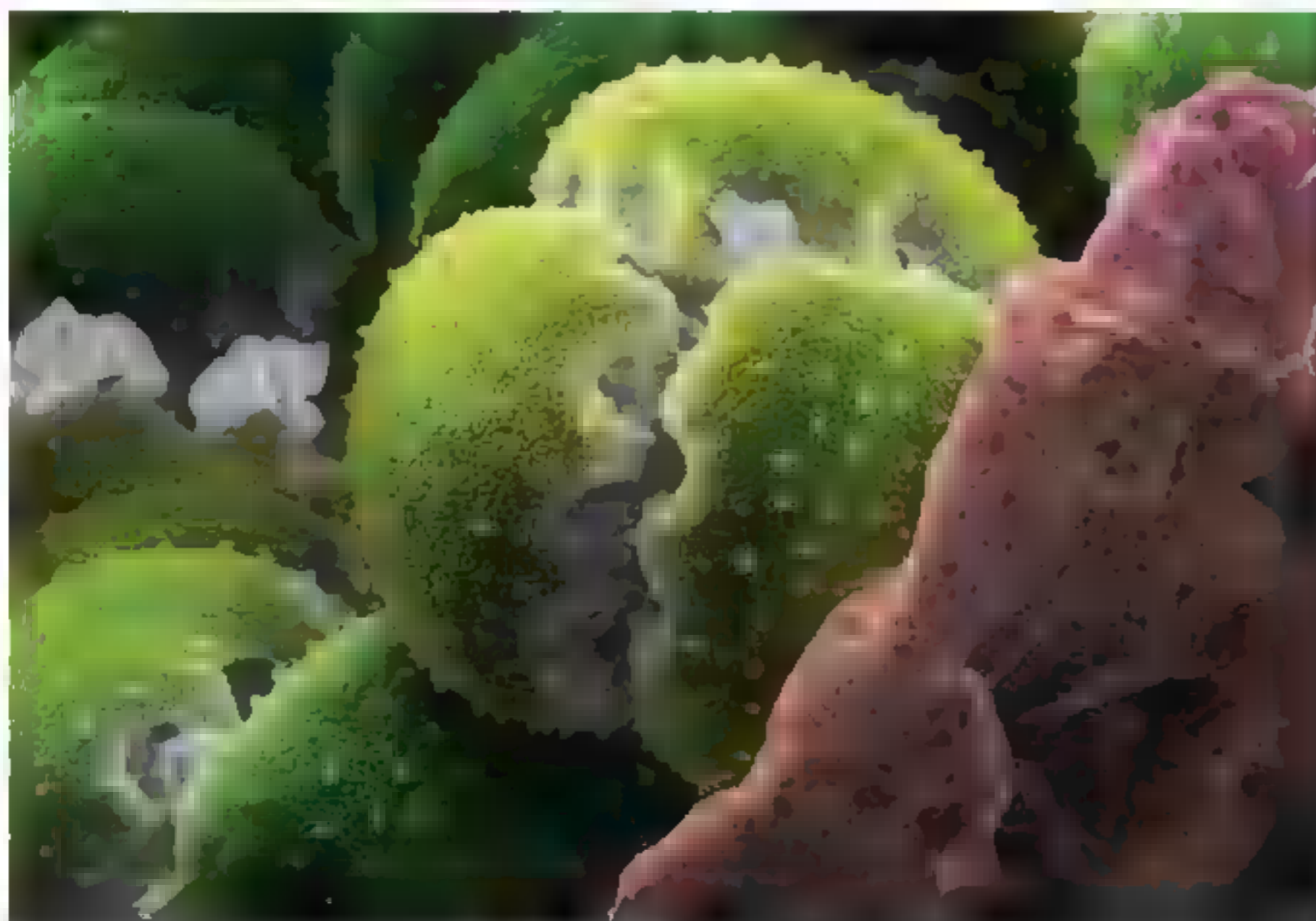


**Silver leaf tree** *PROTEACEAE*





**Bromeliad** *TILLANDSIA MAXIMA*



**Venus flytrap** *DIONAEA MUSCIPULA*



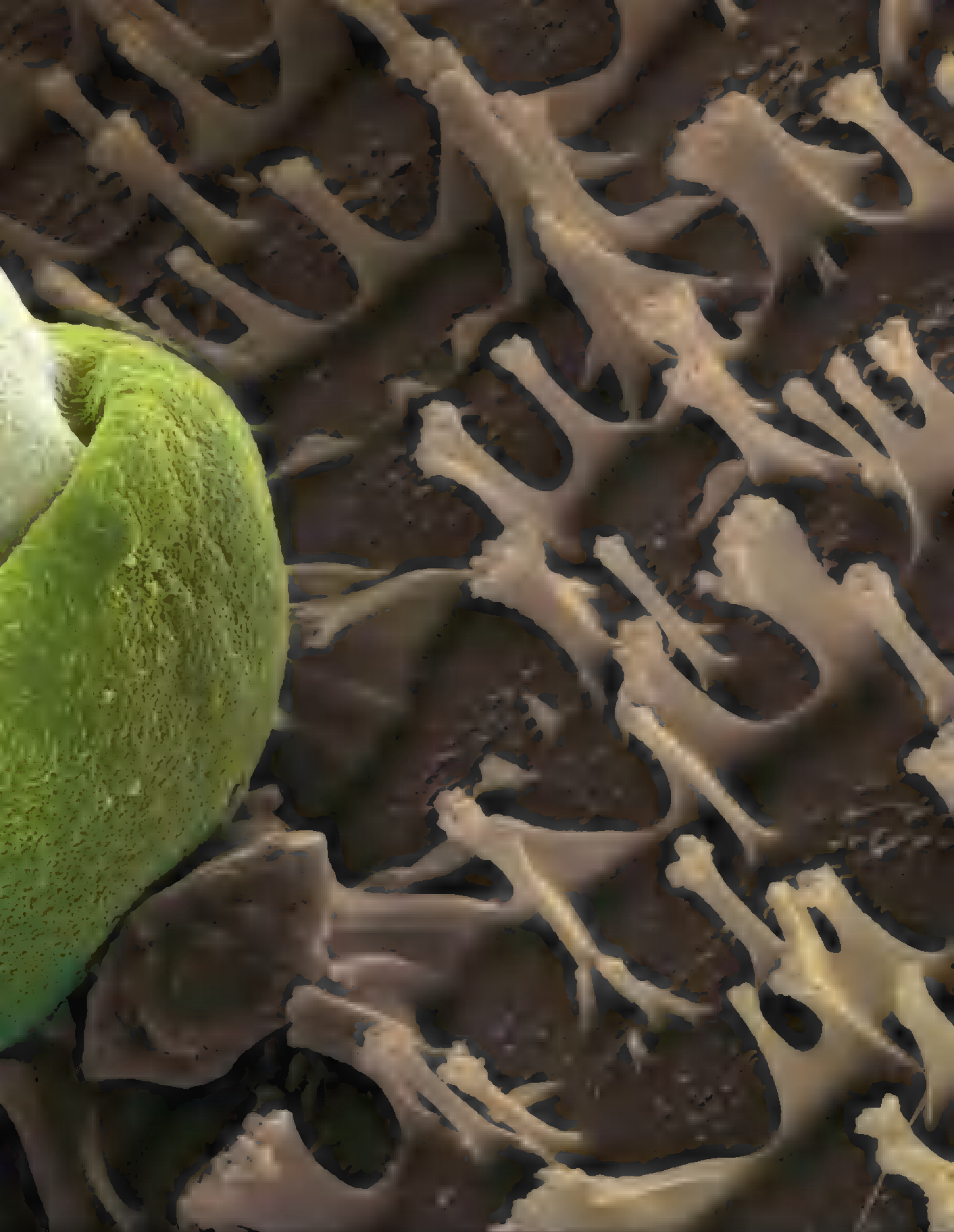
**Poison bulb** *CRINUM JAPONICUM*

## FORM AND FUNCTION


Primordial plant pollen resembled small, smooth planets buffeted in a gusty universe. Over time, evolution has produced a panoply of pollen grains. White clover's protein-rich pollen (top left) is an important food for bees, as is its nectar. Spines on Indian mallow pollen (top middle) help it cling to bird feathers. The fold in a Bromeliad grain (top right) allows it to shrink as it dries, or swell with moisture, without breaking. The ridges on water cabbage grain (center left) are an unusual pollen surface feature, though the plant is common from Egypt to Argentina. Forget-me-not grains (center middle, colored turquoise) are among the tiniest known, each just five one-thousandths of a millimeter across. Venus flytrap (center right) and Persian silk tree (bottom left) grains are more than 15 times bigger: There's no consistent correlation between plant and pollen size. Silver leaf tree grains (bottom middle) have a sticky coating that bonds them to animal carriers. Poison-bulb pollen (bottom right) is surrounded by long, showy petals that attract insect porters. Some variations seem easy to explain. Others remain puzzling, or have yet to be investigated at all.



Pine



The pollen of this family coats cars with yellow-green dust—though this particular grain landed on an unhatched insect egg. It floats through the air, sperm carried by two pale “balloons.” Such wind-borne pollen causes misery for allergy sufferers in much of the world, where it falls heavily, as it has for millions of years.



*The ancient monastic community of Mount Athos—northern Greece still beckons men who seek to satisfy a spiritual hunger. Picking persimmons at dusk, an Eastern Orthodox Christian monk lives much as his brethren did a thousand years ago.*

# CALLED TO THE HOLY



MOUNTAIN



monos Petras monastery was founded in 1257 more  
one of 20 monasteries on the steep-sloped  
pilgrimage site sometimes called the Christian Tibet



BY ROBERT DRAPER

PHOTOGRAPHS BY TRAVIS DOVE

## The holy peninsula of Mount Athos

reaches 31 miles out into the Aegean Sea like an appendage struggling to dislocate itself from the secular corpus of northeastern Greece. For the past thousand years or so, a community of Eastern Orthodox monks has dwelled here, purposefully removed from everything except God.

They live only to become one with Jesus Christ. Their enclave—crashing waves, dense chestnut forests, the specter of snowy-veined Mount Athos, 6,670 feet high—is the very essence of isolation.

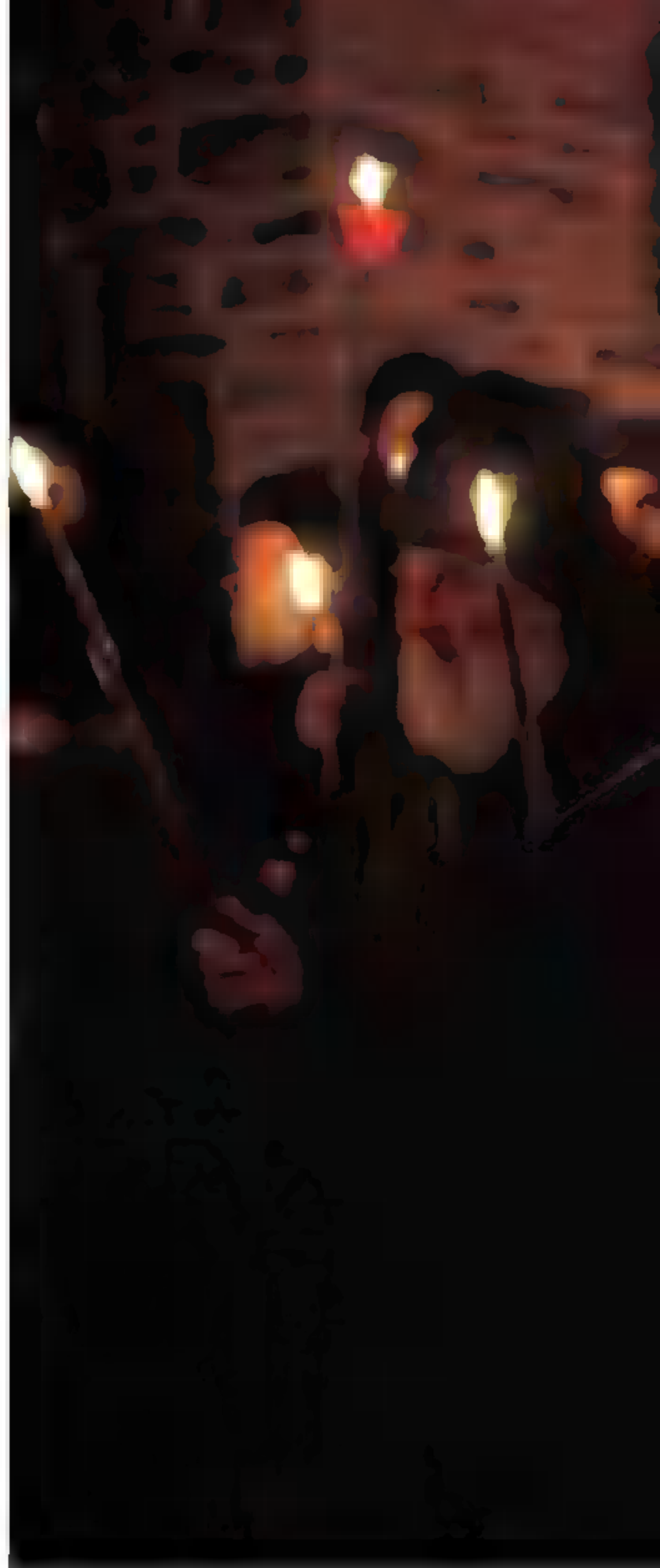
Living in one of the peninsula's 20 monasteries, dozen cloisters, or hundreds of cells, the monks are detached even from each other, reserving most of their time for prayer and solitude. In their heavy beards and black garb—worn to signify their death to the world—the monks seem to recede into a Byzantine fresco, an ageless brotherhood of ritual, acute simplicity, and constant worship, but also imperfection. There is an awareness, as one elder puts it, that “even on Mount Athos we are humans walking every day on the razor’s edge.”

They are men—exclusively. According to rigidly enforced custom, women have been forbidden to visit Mount Athos since its earliest days—a position born out of weakness rather than spite. As one monk says, “If women were to come here, two-thirds of us would go off with them and get married.”

A monk cuts his ties from his mother but gains another: the Holy Virgin Mary (who, legend has it, was blown off course while sailing to Cyprus, stepped foot on Mount Athos, and

---

*Robert Draper is a National Geographic contributing writer. This is photographer Travis Dove's first assignment for the magazine.*



blessed its pagan inhabitants, who then converted). He forms an intense bond with his monastery's abbot or his cell's elder, who becomes a spiritual father and, in the words of one monk, “helps me find my personal relationship with Christ.” The retirement or death of these eminences can be difficult for the younger monks. Conversely, a young man's decision to return to the world may also be wrenching. “Last year one left,” recalls an elder. “He didn't ask for my opinion,” he adds, his voice betraying a fatherly hurt, “so it's just as well that he's gone.”





*Monks chant “Christos anesti—Christ is risen” during a midnight vigil. This Easter gathering ends seven weeks of solemn fasting. Monks rise to pray during the quietest hours of the night because that is when they believe the heart is most open.*

Christian monks (derived from the Greek root *monos*, or “single”) first began forming collective refuges, or monasteries, in the Egyptian desert in the fourth century. The practice spread across the Middle East and into Europe, and by the ninth century hermits had arrived on Mount Athos. Since that time, as civilization has grown more complex, the reasons for distancing oneself from society and turning to monasticism have multiplied. Indeed, after two world wars and communism reduced the monastic population to 1,145 in 1971, the past decades have seen

■ rebirth. A steady influx of young men—often with college degrees, a number from the former Soviet bloc—has dramatically increased Mount Athos’s ranks to nearly 2,000 monks and novices, while Greece’s entrance into the European Union in 1981 made the peninsula eligible for EU preservation funds.

“There are 2,000 stories here—everyone has their own spiritual walk,” says Father Maximos, whose own walk began in Long Island as a teenage devotee of edgy musical artists like Lou Reed and Leonard Cohen, and who later

became a theology professor at Harvard before resigning to “live my life closer to God.”

Many such journeys begin uneasily. An Athens boy sneaks away from his household, and when his brother comes to Mount Athos to fetch him, the boy warns, “I’ll just escape again.” A Pittsburgh grocer’s son stuns his parents with his decision—which, two years later, he acknowledges may be temporary, saying, “I mean, who knows what God has planned?” If the aspirants appear unready, their spiritual father will urge them to go back. Otherwise, the candidate will be tonsured under candlelight: The abbot cuts a tiny cross out of the hair on his scalp, bestows him with the name of a saint, and a monk is born.

Their stories hardly end when they enter Mount Athos. A wayward hippie from Australia named Peter is now Father Ierotheos, an accomplished baritone chanter at the Iviron monastery. Father Anastasios learned to paint here and now exhibits his work in places as far-flung as Helsinki and Granada, Spain. Father Epiphanius took it upon himself to restore the ancient vineyards of Mylopotamos, and today he exports excellent wine to four countries, in addition to publishing a cookbook of monks’ recipes in three languages.

**For better or for worse**, the monastic brotherhood consists of men who finally cannot help but be who they are, fleshed out beneath their robes. Some are independent by nature and opt to live on their own in countryside cells. Some are small-minded—and indeed, as one monk says, “monastery life can be absolutely consumed with pettiness.” However, the very best of them do not merely radiate goodwill but seek out where it’s most needed. Father Makarios of the Marouda cell near Karyes is such a man, freely bestowing on strangers his spare coat, his spare room, all of the money in his pocket. “With real faith,” the 58-year-old monk with animated green eyes says, “you have freedom. You have love.”

The monasteries are anything but monolithic. The seaside Vatopediou monastery is rich with

Byzantine treasures and ambition—among its monks is a full-time music director—while the decidedly agrarian Konstamonitou monastery embraces a rustic lifestyle free of electricity or donations from the European Union. (“You cannot be ascetic with all these easy things,” observes one of its elders.) The monks of Mount Athos did not leave behind their human audacity, attested to by the glorious positioning of Simonos Petras, a monastery suspended high over an infinite seascape as if clinging to heaven’s ladder. Some monks, however, commit to the hermitic barrenness of raggedy huts along the cliffs of Karoulia.

Still others opt for zealotry. Such is the case for the residents of Esfigmenou, a thousand-year-old monastery long tormented by pirates and fires and repressive Ottomans, but now a victim of its own radicalism. Having renounced the Ecumenical Patriarchs’ policy of dialogue with other Christian denominations and hung out a banner proclaiming “Orthodoxy or Death,” the Esfigmenou brotherhood has been cast out by Mount Athos’s ruling body, known as the Holy Community. It now subsists on outlaw defiance and donations from sympathetic corners of the outside world. “We’ll continue our struggle,” declares its renegade abbot. “We place our hope in Christ and the Holy Mother—and no one else.”

To leave Mount Athos for whatever reason is, in local parlance, to “go out into the world.” Of course, the peninsula remains affixed to Earth, and some 2,000 secular laborers share it with roughly the same number of monks. Mount Athos has been part of Greece since 1924. Its local governance resides in Karyes, the dusty capital and depot where shipments from the outside world and newly arrived Eastern Orthodox pilgrims are deposited. (Visitors must apply for a special permit; the Holy Community admits roughly a hundred males for up to four days at a time.)

As the junction between the fixed and the transient, Karyes teems with incongruities: a monk lumbering down the stone pavement with a gnarled cane in one hand and ■ Nike tote bag



### PINNACLE OF PIETY

Center of Orthodox monasticism for a thousand years, the self-governing peninsula of Mount Athos is virtually walled off from mainland Greece by rugged terrain and lack of roads, its 20 monasteries reachable only by boat.

**Elevation profile**  
(view from the southwest)



JEROME N. COOKSON AND GUS PLATIS, NG STAFF

in the other; shops selling candles, rosaries, and bottles of ouzo. The police force headquartered here handles the occasional public intoxication or shoplifting case. In addition, the Holy Community—the world’s longest continually functioning parliament—resides in Karyes. Its members pore over matters as large as relations with the EU and as small as who will rent a particular store. Every change on Mount Athos represents a risk that must be weighed.

Mount Athos has survived by bending where it must, though never without fretfulness. St. Athanasios, who founded the Megistis Lavras monastery in 963, infuriated the hermits by introducing audacious architecture into an otherwise rustic landscape. Roads and buses, then electricity, then cell phones have all been sources of angst. The latest encroachment is the Internet. A few monasteries have conducted ever so timid forays into cyberspace—ordering

spare parts, communicating with lawyers, obtaining scholarly research. “It’s a great danger to be connected to the outside world,” cautions one monk. “Most of the monks weren’t even informed about 9/11.”

The outside world creeps ever closer. Mount Athos’s newest monks have college educations, laptops, and little experience with raising chickens. Yesteryear’s mules have mostly been replaced by vans and Range Rovers. Worries persist that the European Union donations will continue only with strings attached—such as the insistence that women be permitted to visit the peninsula. In these ways Mount Athos cannot elude mortal preoccupations.

Yet the brotherhood proceeds as it always has: inchwise, turned ever inward, glorying in the unseen—“digesting death,” in the words of one of its preeminent scholars, Father Vasileios, “before it digests us.” □



**PATH TO SANCTITY** *Sounding a call to prayer with the rap of a mallet on a wooden board, a monk leads an Easter procession of fellow monks and lay visitors. Guarded by 6,670-foot-high Mount Athos (below, in background) and laced by rustic paths still traveled on foot and by mule (bottom left), the enclave's low-tech serenity attracts tens of thousands of pilgrims yearly—men only. Dedicated to the Virgin Mary, the peninsula is off-limits to all women and the temptations they might represent. Father Mardarios (top left), a former nightclub bouncer, applies his brawn to clearing ground for a garden. "Too many rocks," he grunts, "like my sins."*







*These two monks have shared the same small cell for more than 50 years. Humor helps maintain harmony, as does respect for seniority. Father Nektarios (at left) says of Father Christoforos, "He's followed my will as the elder all these years."*



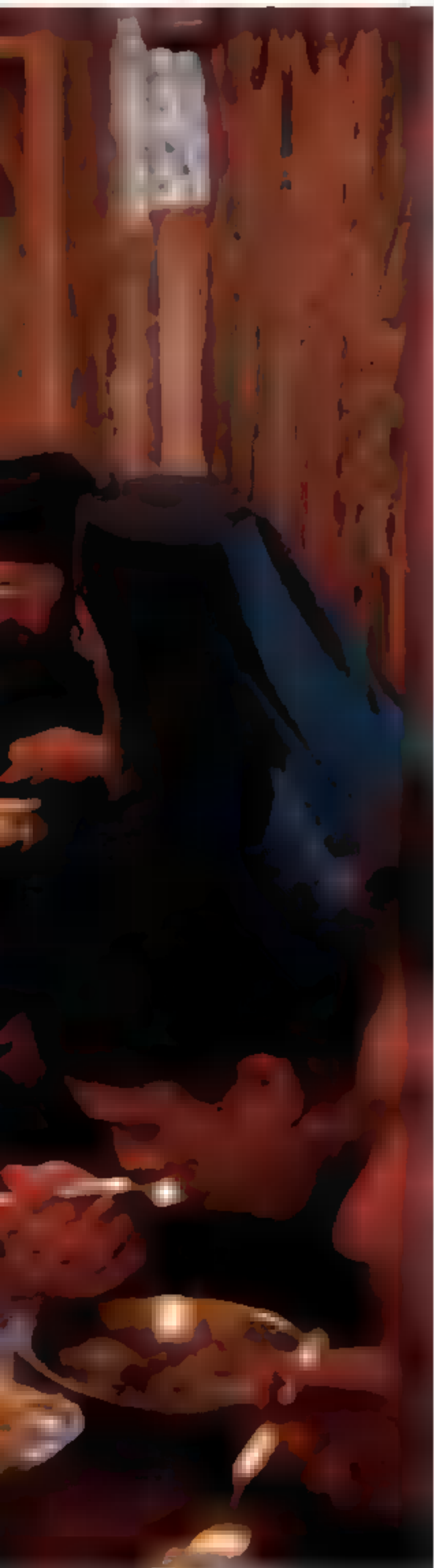




*Monks of Esfigmenou monastery gather olives as they always have. But their vocal disdain of Orthodox patriarchs who have sought reconciliation with the Roman Catholic Church has led Mount Athos's ruling body to disown them.*

**ETERNAL BROTHERHOOD** *A monk forsakes one family to join another. He communes with his brother monks at mealtimes—albeit silently, as in the ornate Byzantine refectory of the Xenofontos monastery (below). The monastery's abbot becomes his spiritual father, though all elders are approached with deference (bottom right). The monks remain united even in death: Their bones are washed in red wine—echoing an ancient Greek custom—and placed together in an ossuary (top right). Says Father Makarios of Simonos Petras, “For those who consider themselves already dead to the world and are living for God, leaving this world is easy.”*





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"We believe in the work of National Geographic and wanted to be involved," says John Spinelli. He and his wife Shirley grew up reading *National Geographic* magazine and passed that love on to their children and grandchildren. Now retired, they enjoy in-line skating, tennis and bird watching.

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Hadza hunters Sapo (at left) and Mahiya (at right) smoke with Schoeller.

## ON ASSIGNMENT Not Quite Quitting Time

Three days spent fruitlessly pursuing antelope across the plains of Tanzania gave photographer Martin Schoeller plenty of time to bond with his Hadza hunting mates. Bouts of waiting for the beasts to reveal themselves were punctuated by friendly banter and breaks for tobacco. "Many of the Hadza smoke frequently," explains Schoeller, who brought his own cigarettes with him on the excursion. The Hadza often use hand-carved stone pipes to smoke their tobacco, which is dark and strong. Schoeller tried some and instantly felt its punch: "We all shared a good laugh when I coughed," he recalls. His African friends, however, took easily to Schoeller's comparatively tame cigarettes. "They seemed to enjoy the lighter smoking experience," he says. If there was a downside to the hunting trip—aside from catching nothing but a squirrel—it was Sapo's tooth infection and swollen cheek. Schoeller wanted to drive him to the hospital to have it checked out, but Sapo refused the offer. He did, however, accept another smoke.

## Society Updates



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How does a contortionist bend her body in half (above) and not hurt herself? Scientists and doctors decode this and other confounding physical feats in *Humanly Impossible*. Two episodes air back-to-back on December 6 at 8 p.m.

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The Court will determine whether to approve the Settlement and attorneys' fees at a Fairness Hearing held on **February 8, 2010**.

The Court has appointed lawyers to represent you at no cost to you. You may choose to hire your own lawyer at your own expense.

**For Information About the Proposed Settlement, Your Legal Rights and Filing a Claim:**

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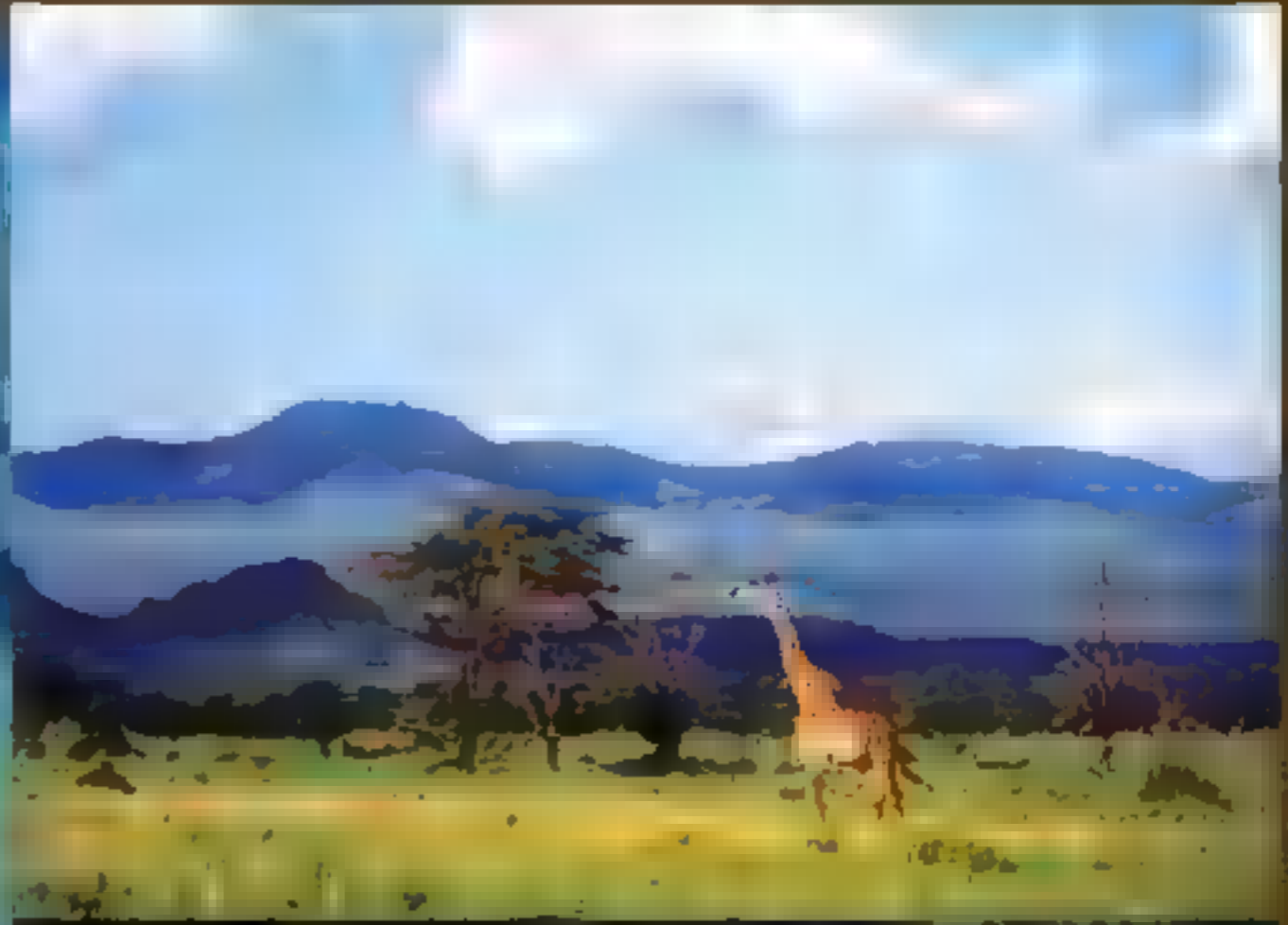
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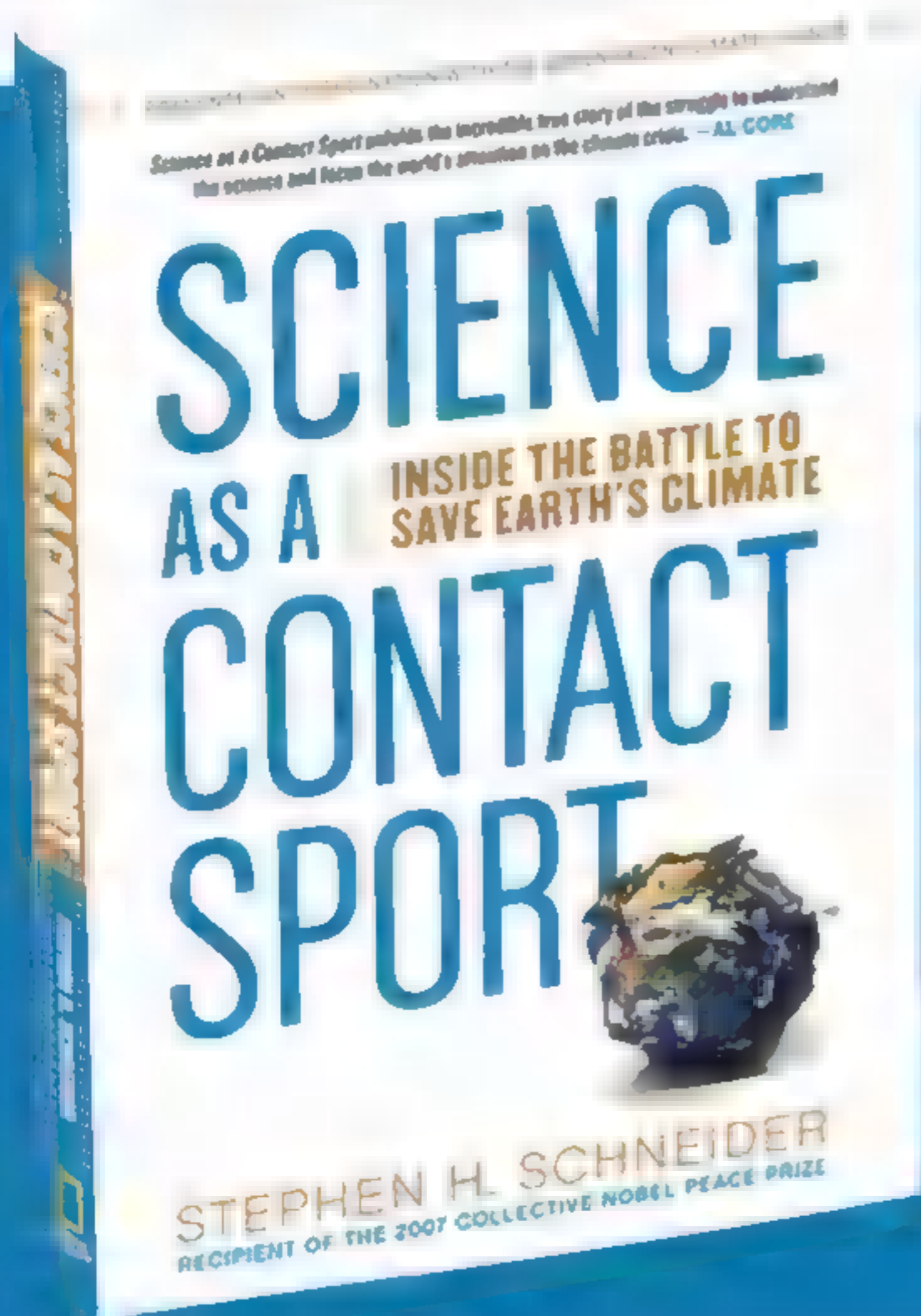


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**Big Bloom** In the Indonesian wilds, the six-foot-plus flower of the *Amorphophallus titanum*, or krubi plant, emits an odor like rotting flesh to lure pollinating carrion beetles. At the New York Botanical Garden in 1937, it attracted crowds instead. Despite tender care and frequent repotting, this krubi had not flowered since the garden's acquisition of its 60-pound tuber in 1932. By 1937 the tuber had packed on another 53 pounds—and its blossoming proved a surprise. Though the garden's botanists coaxed a second krubi into flower in 1939, and several of the plants remain in its collection, no *A. titanum* has bloomed there since. —Margaret G. Zackowitz

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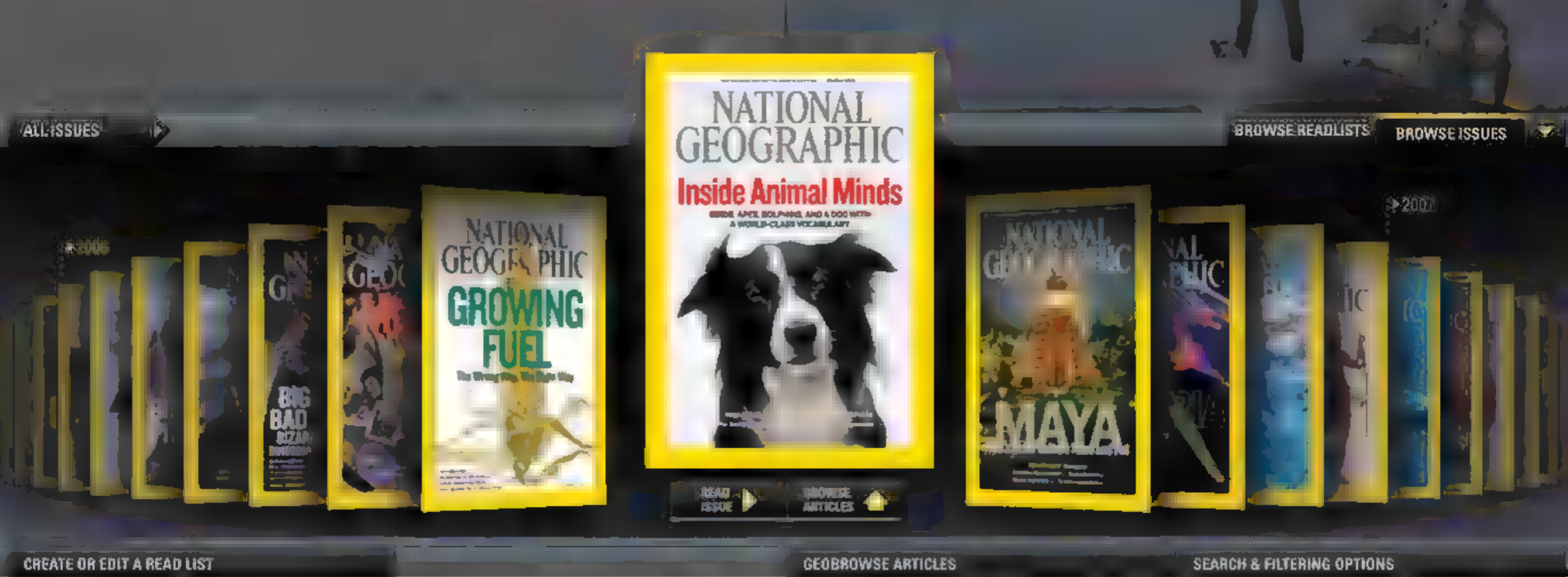
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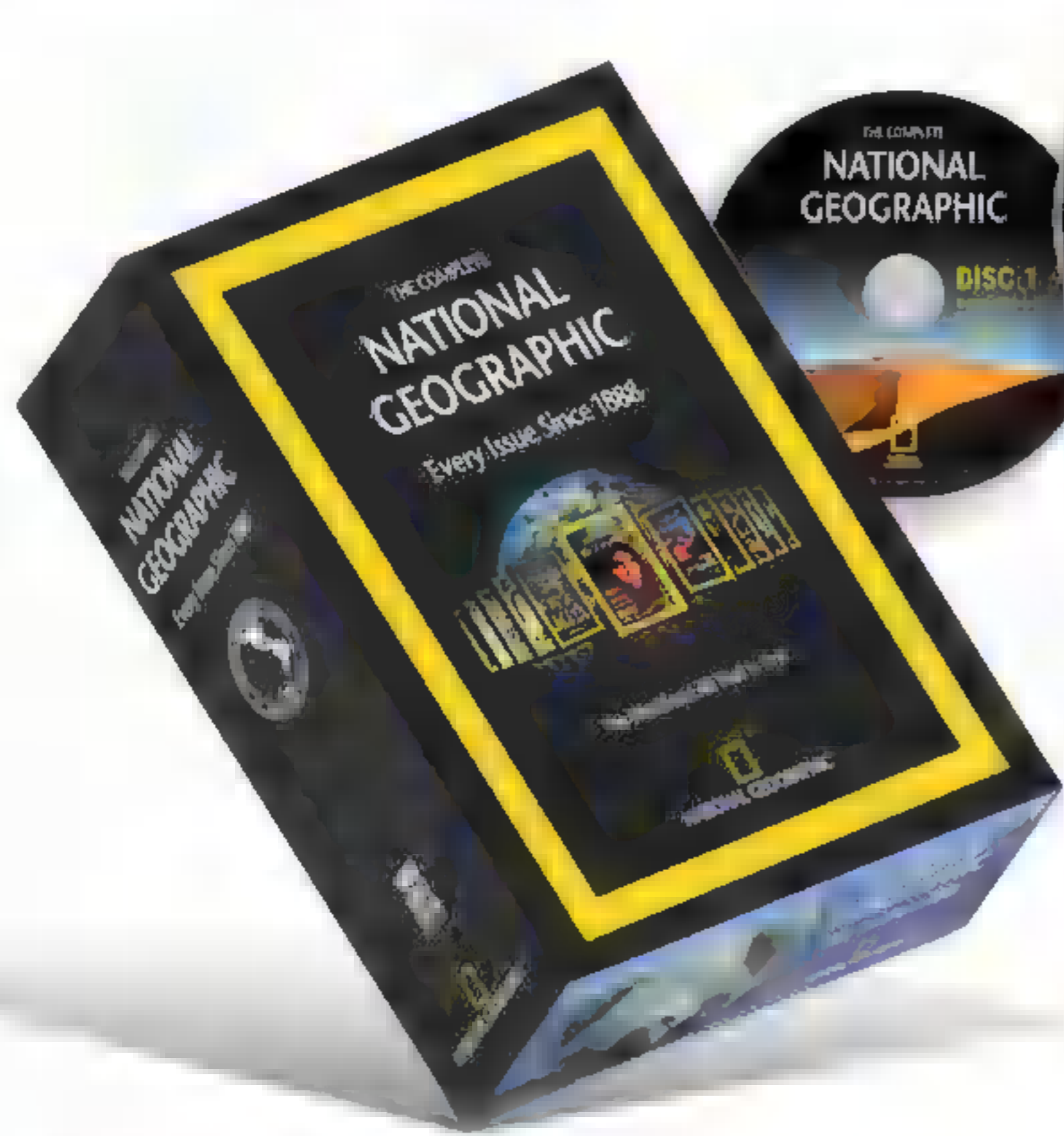
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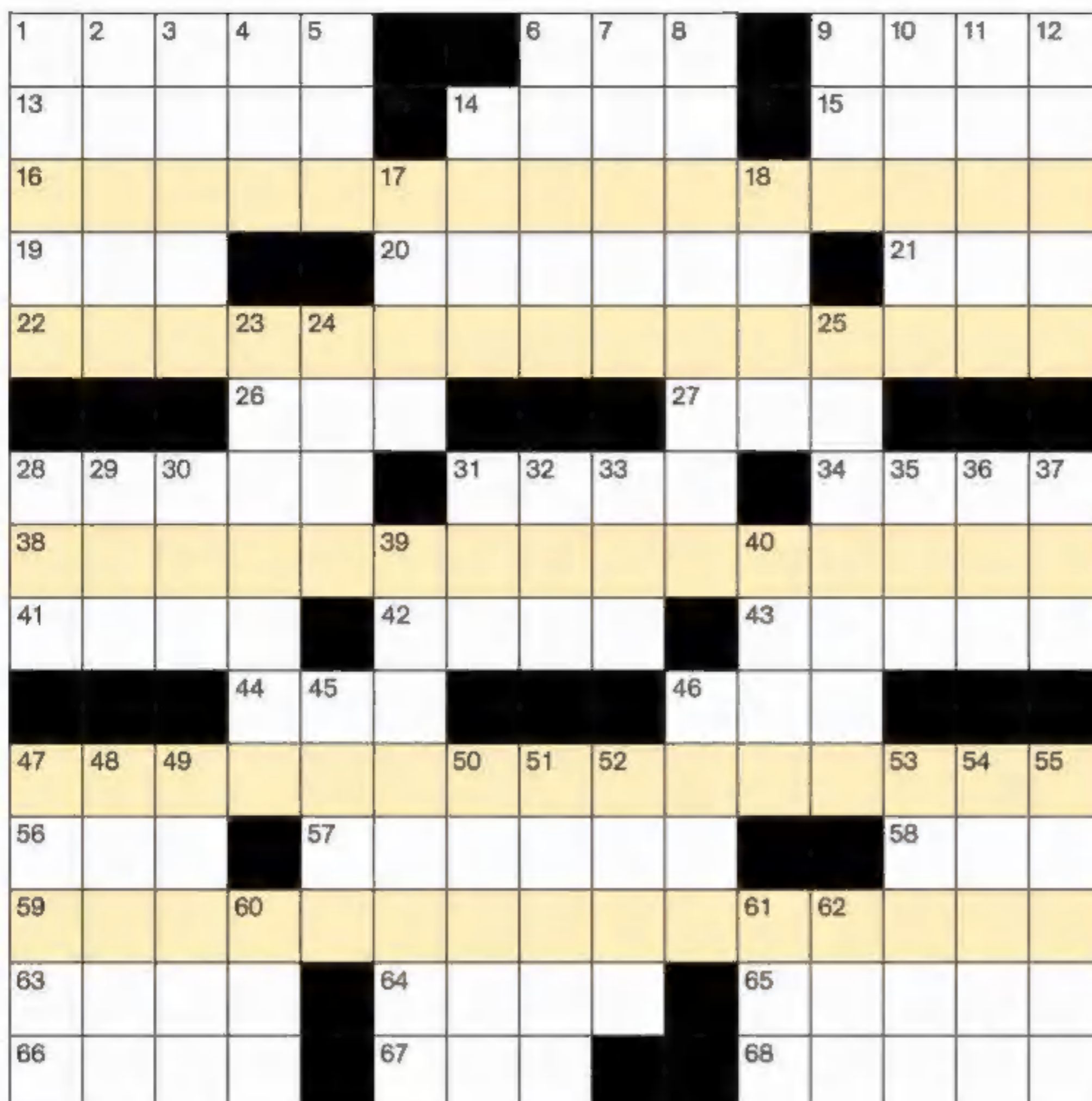


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# GEOPUZZLE



## Paradox Island

Puzzle by Cathy Allis

It is icy yet improbably green in parts. Bright sun can swiftly turn to howling bluster. Its animals fell prey to hunters but have had a major revival. Tinted clues pay homage to mercurial South Georgia. For hints to the puzzle, read "Resurrection Island," page 56.

### ACROSS

- 1 Produce offspring, à la glaciers, whales, and 22 Across
- 6 "Spring ahead" abbr.
- 9 Like some vaccines
- 13 One may go on it
- 14 Kodiak, for one
- 15 "The doctor \_\_\_"
- 16 Atmospheric condition, literally, in a South Georgia rookery
- 19 It may blow hot and cold
- 20 \_\_\_ d' (headwaiter)
- 21 Back in time
- 22 South Georgian female with a three-mammal name

- 26 Third qtr. mo.
- 27 Mid-11th-century yr.
- 28 Lagoon's surrounds
- 31 Its hips may be in tea
- 34 Hair line
- 38 South Georgia suffers from a meteorological version of this
- 41 Words with a point or par
- 42 Netizen, for instance
- 43 Sailor-collared blouse
- 44 "Krazy" comics character
- 46 Hibernation location
- 47 South Georgian bird with something special in its "cap"

- 56 Outgrowth of punk rock
- 57 Ethically indifferent
- 58 22.5 deg. compass point
- 59 "Icons of the great white continent" seen off South Georgia
- 63 University founder Cornell
- 64 "Oil \_\_\_ Blues" (theoretical song about whaling stations)
- 65 Dolt
- 66 Caboose
- 67 Nabokov novel
- 68 Certain NCOs

### DOWN

- 1 Espresso, e.g.
- 2 "It's \_\_\_!" (We're in business!)
- 3 NPR host Hansen
- 4 Lab's doc
- 5 Verb suffix of yore
- 6 Payment option
- 7 Cures, perhaps
- 8 Three-level ancient galleys
- 9 Big-screen Cleo, in 1963
- 10 Son almost slain by Abraham
- 11 One born on Labor Day, e.g.
- 12 Furnish with funding
- 14 Dietary fiber source
- 17 Online pub
- 18 Fervor
- 23 Big oaf
- 24 Frigate's frame
- 25 Facial-piercing adornment
- 28 \_\_\_ Dhabi, Persian Gulf capital
- 29 Hint that may be hot
- 30 Choose
- 31 B&O and others
- 32 Poetic tribute
- 33 Title for Caine or Connery
- 35 Contribute
- 36 Color of krill that feed South Georgia's wildlife
- 37 Sample
- 39 Robots
- 40 What a melting Pole or scarce krill year may be
- 45 Receding sea inside Asia
- 46 "Strike this," in proofing
- 47 A poem's has feet
- 48 Blow away
- 49 Hooded snake
- 50 Defense acronym
- 51 One of Chekhov's "Three Sisters"
- 52 Kind of ice that crushed Shackleton's ship
- 53 Strip of gear, as a ship
- 54 Bar of gold
- 55 Vespiaries and aeries
- 60 Bygone Egypt-Syr. alliance
- 61 Twice, musically
- 62 'Zine team

Answers in  
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